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Of Nature trusts the mind which builds for aye."—WORDSWORTH

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, NOVEMBER 4, 1909.

MODERN WELDING.

Welding and Cutting Metals by Aid of Gases or Electricity. By Dr. L. A. Groth. Pp. xvi+281. (London: A. Constable and Co., Ltd., 1909.) Price 10*s.* 6*d.* net.

THE art of welding iron is very old, probably as old as the production of the metal from its ores. Previous to the nineteenth century the art of forging and welding iron reached a high stage of development. Then came the cast-iron period, which for a time usurped the place of the forged metal. But during the last half-century, owing to improved and less costly methods of production and the introduction of machines which can make forgings of a size far greater than can be worked by a smith, new methods of welding have become necessary. Welding of the metals has kept pace with the improvements in metallurgy, and a great part of it is now carried out by fusion; consequently, joins of almost any thickness can now be made, whereas by the method of hand hammering the size and thickness of the joins was very limited.

The book before us deals with the welding of metals mainly by the newer methods which have been made possible by the advance in electrical science and by the use of reducing flames of high temperature, such as hydrogen and acetylene. But not only can high-temperature flames be employed for welding; they can also, by altering the conditions, be used for cutting thick plates of metal. Whereas, however, the welding is carried out by means of flames containing an excess of a reducing gas, the cutting is done by means of flames rich in oxygen.

The book commences with a short introduction explaining the nature of a weld. Chapter ii. is headed "Gases and Sources for their Generation." One hardly knows what to make of this chapter; if it is written for the novice it is useless, if written for the chemist unnecessary. We are told, in the first place, "it has been known for ages that matter is capable of existing in three physical states: the solid state, the liquid state and the gaseous state."

Further on there is an historical account of the manufacture of calcium carbide and of the preparation of acetylene. It is a pity that this part of the book is not written in a manner to help the welder or cutter, and is not always accurate. What, for example, does this mean?

> (Hydrogen) "is usually prepared by the action of zinc or iron on a solution of hydrochloric or sulphuric acid. All metals which readily decompose water when heated readily furnish hydrogen on a similar treatment. Many other acids may be used, *but none cut more readily*. In all cases the action consists in the displacement of the hydrogen . . . and if the acid is not one which can enter into reaction with the displaced *nitrogen*, the latter is evolved as a gas."

Poor novice! Again, hydrogen was not liquefied by Cailletet on December 30, 1877.

From chapter iii. and onward the book is interesting and instructive. Welding and the different systems employed are described—thus autogenous, or the union of the metals by direct fusion; under this we get alumino-thermic processes, electric welding, welding with compressed gases. Heterogeneous, in which a foreign metal or alloy is employed, which has a lower melting point than the metals to be joined.

The welding of aluminium, which is similar to lead burning, is described, and illustrations are given to show that, as a rule, the tensile strength of a welded bar is greatest at the weld, or, at any rate, breaking does not take place at this position. The alumino-thermic process is well described, and two interesting diagrams showing the mending of cracks in the stern frame of a steamer are shown.

A considerable amount of space is devoted to electric welding, which has been found so useful in the welding of pipes and tubes; very interesting illustrations showing the joining of pipes to form T's and other unions are given.

Chapter iv. deals with blow-pipes of various design which are used for different purposes. We are not particularly impressed with the insertion of advertising letters in chapter v. This chapter deals with the welding of sheet-iron, and various methods are described. But surely it should not be necessary to print letters from the Public Works Department of Perth, W. Australia, and from other bodies, writing in appreciative terms of a certain process which, as we are not advertising it, we need not mention. To our mind, in book-writing the author should use his own judgment, which may or may not be influenced by letters of recommendation, but it says little for his analytical skill if he finds it necessary to print the letters.

The part of the book dealing with the welding and cutting of metals is extremely interesting, and illustrates the great advance which has recently been made in this direction. In all autogenous processes a reducing flame which prevents the formation of oxides is a *sine qua non*; but when a flame is to be used for cutting purposes the reverse is the case. Most metals, when heated to a sufficiently high temperature, will burn in oxygen. This property is made use of in cutting steel, for example. An oxy-hydrogen flame is caused to impinge upon the metal, and at the same time an auxiliary blow-pipe directs oxygen gas upon the heated surface; immediate combustion ensues. The stream of oxygen is sufficiently powerful to drive away the oxide as it is formed, and the cutting progresses very rapidly. For example, an armour plate 6·3 inches thick was thus cut to a length of 1 metre in ten minutes. At Bremen a similar process has been employed for cutting up and scraping ships.

The book is suggestive, useful, and will, we hope, enjoy a large circulation in spite of the few errors here pointed out, and when the second edition is being prepared we trust the author will take notice of our friendly criticism.

F. M. P.

PROBLEMS IN NUTRITION.

Volksernährungsfragen, and *Kraft und Stoff im Haushalte der Natur.* By Prof. Max Rubner. Pp. iv+143 and 181 respectively. (Leipzig: Academische Verlagsgesellschaft, 1908, 1909.)

THESE two little books contain three useful and readable essays on those nutritional problems to which Prof. Max Rubner has directed most of his research work. The first of the above-mentioned books contains two of these, and they treat of the minimum protein requirement of man and of diet of the poor respectively. The first question has within recent years been brought prominently before the scientific world, as well as the public at large, by the work of Chittenden and others, who argue from their experiments that, because they themselves have been able for limited periods to maintain their health and equilibrium on an amount of protein which is far below the usually accepted Voit minimum, therefore all men should permanently reduce their intake of protein to the same low level. Those who believe that the minimum is also the optimum would do well to read and consider carefully the Berlin professor's judicial commentary on their views.

What most strikes the reader is the extraordinary complexity of the problem. One factor, however, is absent, and that is the effect of work and rest, for this causes practically no effect on the metabolism of protein matter; but the question is sufficiently complex without this. There is between different people an enormous variation in what one may term their metabolic habits, so that any hard and fast rule is impossible. The mere body weight is not an important element, although, naturally, the heavier a man the more protein will he require. If this were all, it would be easy to adapt the dosage to the body weight; but the difference is deeper than this; to mention one point only, it is shown that, as a rule, the thin person requires more protein to maintain nitrogenous equilibrium than the corpulent. It must have been a matter of common observation that the stoutest people are not the biggest eaters. Another complicating factor is what one eats with the protein, and also the kind of protein one ingests. It is shown that on a potato diet, for example, the minimum necessary to maintain nitrogenous equilibrium is less than with any other of the diets adopted. We have further to take into account the presence, in most foods, of nitrogenous substances which are not protein, but which, nevertheless, have to be reckoned with.

The second essay, on the diet of the poor (agricultural labourers and the like), emphasises very clearly one reason why a low protein intake brings the consumer dangerously near to the margin. It is shown beyond question that such a diet renders people much more prone to take infectious diseases, and there is a general lowering of the powers of resistance. Considering that the bulk of the population consists of those who are not well to do, this becomes a matter of national importance, and it is the duty of the State to interfere. Prof. Rubner appears to think that legislative measures should be adopted. We can see, however, that the difficulty of legislating on such a matter is very great; but at least the people should be educated on the question of feeding rationally, especially where children are concerned. Anyone with any experience of hospital patients knows that ignorance, in addition to poverty, is at the bottom of most of the conditions of malnutrition which meet us at every turn. Ignorance, moreover, is not confined to the poor in regard to this most important question.

The third essay, which occupies the second volume, is a summary of Prof. Rubner's work on nutrition generally; it is written in a more popular manner than most of his publications, and a distinct philosophical vein runs through it. The chemical events which occur in the living body fall mainly into two categories—(1) those due to the activity of enzymes; in these there is but little transformation of energy; and (2) those which may roughly be described as combustion, and from which the energy of living and doing is derived. It is the second class of chemical changes to which Prof. Rubner has mainly directed his attention, and it is to him, in particular, that we owe the experimental proof that the law of conservation of energy applies to the living cell as well as to the world of inorganic matter. The law of the conservation of energy is so universal that one might, perhaps, have assumed it would hold for living as well as for lifeless material. But the scientific mind assumes nothing without direct proof; we have no right to assume beforehand that some other law might not be found operating in the organic world. The crude calorimetric researches of Lavoisier and the early pioneers of this subject certainly showed great discrepancies between the results obtained and those calculated from the energy value of the diets employed; but as technique has improved so has it been shown that all such discrepancies were the result of imperfection in the methods used. For the improvements in method, and the patient working out of the problem as well as the final demonstration of the truth of the great law of energy conservation in the world of life, there is no one to whom we owe more than to Prof. Rubner himself.

W. D. H.

COLOUR MANUFACTURE.

A Treatise on Colour Manufacture. A Guide to the Preparation, Examination, and Application of all the Pigment Colours in Practical Use. By George Zerr and Dr. R. Rübencamp; authorised English edition by Dr. Charles Mayer. Pp. xiv+605. (London: C. Griffin and Co., Ltd., 1908.) Price 30*s.* net.

THIS volume is the most complete publication on colour manufacture which has yet been produced in English. After dealing with the general preparation of materials, and describing the various types of grinding and sifting machines, in part ii. the manufacture of artificial mineral colours in dealt with in a very thorough manner, although in certain details inaccuracies are, as is to be expected, to be found.

Part iii. deals with the raw materials used in colour making, their properties, adulterations, and tests for purity. This section should prove very valuable in many colour works where the raw materials are bought in large quantities, and reliable information of this kind will enable them to be readily examined to test their purity.

The natural mineral colours and black pigments are then dealt with, and following upon this is a description of organic colouring materials and their utilisation in making lake pigments. The first section deals with natural organic substances, while the second section deals with the application of the coal tar colours to the manufacture of lakes. This section should prove of considerable value to colour makers, as it contains a scientific classification of the coal tar derivatives, and so reveals the principles upon which such lakes must be prepared. It is, of course, impossible that such a treatment of the subject should be up to date, as fresh coal tar products and fresh methods of obtaining trustworthy lakes from them are constantly being produced, but a study of these chapters will give the student a thorough grip of the principles underlying the manufacture of these lakes, and some interesting information will be found at the end of this section of the book on the reactions of the more important lakes from artificial colouring materials, which should be of use to those who wish to match samples that have been submitted. There is also a brief account of the use of pigments in different ways which, while very general in character, contains some very interesting information.

In the appendix will be found a table of solubilities of many of the salts used by the colour maker, in cold and in hot water, which should prove of practical value, while there are in addition specific gravity tables for a certain number of these salts which should also be of use.

As has been stated, there are certain errors in detail to be noted, more especially in connection with the finer colours which are used for artists' purposes, and two of these which happened to have caught the eye of the reviewer may be pointed out. On page 154, Indian yellow is incorrectly described as being the same thing as cobalt yellow, Indian yellow being a preparation of euxanthic acid obtained from India, and cobalt yellow is described as being not very fast to air and light, while, as a matter of fact, it is one of the most permanent pigments to be found in the artist's palette. Again, under blue colours on p. 203, cobalt blue is spoken of as being now of no technical value. Considering the very large use of cobalt blue by artists and for superior decorative purposes, this statement is scarcely justifiable. The description of the manufacture of cadmium yellows is also very far from complete, and no doubt other similar small errors could be found throughout the book, and are inevitable in a work of this kind.

A more serious defect is one which is to be found in a great many works on colour manufacture. While elementary information on qualitative and quantitative analysis is published—see, for instance, the discussion of the methods of volumetric analysis on p. 343—information which it is only right to suppose is perfectly familiar to the modern colour maker and colour chemist, and simple qualitative tests are given which are to be found in all elementary books on qualitative analysis, little information is supplied as to the complete analysis of modern pigments. Such information would be of value even to the skilled analyst, who, when he comes across some pigment, wishes to know the probable defects to look for, the kinds of adulteration likely to be present, and the most rapid manner of handling with a view to making a sufficiently complete analysis for practical purposes. Some attempt to deal with this problem was made by Hurst in his book on pigments, but a more complete scientific handling of the subject is very much required.

In conclusion, this book may be safely recommended to all those interested in colour manufacture, as containing a great deal of useful and valuable information brought together in a clear and practical form.

UNIVERSITY ADMINISTRATION.

University Administration. By Charles W. Eliot. Pp. 266. (London: Constable; Boston and New York: Houghton, Mifflin and Co., 1909.) Price 6*s.* net.

UNIVERSITY politics has long been a current phrase, and questions of university government and policy have been increasingly discussed of recent years; yet, in spite of the rapid increase in the number of the English universities, and of the many interesting experiments in organisation which they embody, there has so far been no comprehensive treatise written in this country upon university administration. The gap is now filled, though from the other side of the Atlantic, by the late president of Harvard, who has condensed his thirty-nine years of experience as the ruler of the most famous of the American universities into a book which will long rank as the standard authority on the subject. Written with admirable clearness and precision, it states and discusses sensibly and practically problem after problem with which English readers are familiar in newspaper discussions on university reform, but which it is not easy to see in their wider bearings.

The book is divided into six chapters, which deal successively with university trustees, inspecting and consenting bodies, faculties, the elective system, methods of instruction, concluding with a chapter on the social organisation of a university, the position of the president, and several questions of general administration.

The most novel and interesting chapter in the book is undoubtedly that on the elective system, the introduction of which at Harvard has been the main feature of President Eliot's *régime*, and which he is at pains to explain and defend. He describes it as a "carefully arranged scheme of numerous courses of instruction which are open to the choice of students under rules partly artificial but chiefly natural and inevitable." Its effect is to give the individual student, not unlimited, but still far more extensive opportunities of "following his bent" in the choice of his university course than he gets under the fixed courses in subjects or groups of subjects which are usual in English universities. President Eliot claims that, if strictly administered, it satisfies the needs of serious students with intellectual initiative of their own who are apt to feel cramped by a rigid college course, while for the mediocre and unambitious it offers the "only chance of experiencing an intellectual awakening while in college." At the same time, it gives every teacher the precious privilege "of having no student in his class who has not chosen to be there." Its main difficulty is, of course, that it is very much more expensive than the "prescribed" system.

President Eliot's two chapters on university government will be read with interest in this country, especially in view of Lord Curzon's recent book on the government of Oxford, which, written from a wholly different standpoint, affords a striking illustration of some of Prof. Eliot's views. Harvard, which President Eliot regards as "the university with the most fortunate organisation in the country," is governed by a body of trustees, seven in number, controlled by a body of thirty overseers, elected by the whole body of Alumni, who exercise, through visiting committees and otherwise, powers of inspection and veto. The overseers thus play the part of the whole body of M.A.'s of Oxford and Cambridge, only with vastly increased efficiency, because they are a representative committee, and not an unorganised mob periodically assembled by a whip. Lord Curzon's recent proposal to constitute at Oxford a new finance board of eight or ten members, partly non-residents, to exercise a general control over college and university finance, is thus clearly on the lines of the American boards of trustees; but President Eliot's book throws no light, of course, on the main difficulty of university organisation in the older universities, the relation between the university and the wealthy and autonomous collegiate corporations which have grown up in its midst.

PROBLEMS OF IMMORTALITY.

Unsterblichkeit: eine Kritik der Beziehungen zwischen Naturgeschehen und menschlicher Vorstellungswelt. By Hermann Graf Keyserling. Pp. iv+349. (München: J. F. Lehmanns Verlag, 1907.)

COUNT KEYSERLING has chosen a subject upon which the views even of a dull man are frequently interesting, if only as a "document," and he has treated it in a manner that makes his book a notable contribution to its serious study. He is broad-minded and well informed; he develops his argument lucidly and consecutively, and he illuminates it with considerable literary grace.

An examination of the data of the famous argument for immortality which appeals to the consensus of mankind, *semper et ubique*, shows that, in reality, it gives no support to any specific form of the doctrine. The concepts of future existence described by ethnologists and historians differ enormously, not only in detail, but even in principle. If, then, we continue (as does the author) to attach importance to the consensus, we must regard it as giving a merely formal guarantee of some kind of post-vital permanence which it is impossible to specify. To be assured that it has this value requires a critical examination of the nature and functions of faith (*Glaube*). Faith is to be identified neither with an unverified belief in matters that may eventually become the objects of certain knowledge, nor with a confidence in things of which certain knowledge is, by the nature of the case, impossible; it is a specific activity of the soul in which it fastens upon, or recognises, the ultimate assumptions of a causal or logical nexus. It is by faith that I recognise the validity of a geometrical axiom, the existence of God, the reality of the objective world, and the correlated reality of my own subjective existence. I may be mistaken in the particulars of my assumptions under any one of these heads—as I am, for instance, in perceptual illusion—but in no case can my final certainties rest upon any other ground than faith. The possibility of error in the contents to which faith attaches merely illustrates its purely formal character as an epistemological function. It follows from this definition that faith is not a temporary phase, but a permanent and essential constituent of the human movement along the lines both of thought and of action. There is, in fact, a "conservation of faith" within the subjective world analogous to the conservation of energy in the physical world—the one regulating our recognition of Being much in the same way that the other regulates our recognition of Becoming.

Examining the character and contents of human experience by the aid of this theory of faith, the author finds that it yields no support to the belief in a continued personal existence. On the contrary, he detects in the moral consciousness a recognition that the permanent element in us is an Entelechy that produces our "personality" as a purely temporary phenomenon, and will in due time pass upon its way. It draws from an underlying sea of infinite, unimaginable Being, and our individualities are, as it were, merely the waves in which, from moment to moment, the ceaseless movement of this sea expresses itself.

It is unlikely that the reader will be able to agree with all Count Keyserling's views; in particular, he will probably feel that the concept of faith as a purely formal function is by no means clear. His dissatisfaction with this part of the argument will not, however, interfere with his appreciation of the ability with which the author has conducted his inquiry and of the stimulating manner in which he has presented his results.

T. P. N.

DESCRIPTION OF NEW MINERALS.

Second Appendix to the Sixth Edition of Dana's System of Mineralogy. By Edward S. Dana and William E. Ford. Pp. xii+114. (New York: John Wiley and Sons; London: Chapman and Hall, Limited, 1909.) Price 6s. 6d. net.

THE debt of gratitude that mineralogists, and, indeed, all interested in the physical and chemical characters of the inorganic products of nature, owe to the Danas, *père et fils*, is immense, and can scarcely be realised owing to the human propensity to take for granted all that is provided to hand. The task of compiling such a compendium is without ending. Mineralogy, like all branches of science, does not stand still, and no sooner has an edition appeared than it begins to need expansion and revision. The larger a work of this character becomes, the greater is the difficulty in bringing out fresh editions at short intervals; yet something must be done if pace is to be kept with the growth of mineralogical science. In the present instance the problem has been solved by the issue of a series of appendices. The last edition, which was the sixth, of the "System of Mineralogy," was produced by Prof. E. S. Dana in 1892; the first appendix was issued in 1899, and now, ten years later, the second appendix has appeared.

In the present volume the same plan has been followed as in the first appendix. It opens with a list of the principal works that have been published within the period dealt with, and a list of new mineral species classified according to the arrangement of the system. The rest of the book is occupied with a concise but complete description of the important characters of the new minerals, such as the crystallographical and optical constants, the values of the principal angles, the colour, the specific gravity, the chemical composition and the response to the ordinary reagents, and the locality whence they were obtained; and, further, with an abstract of work that has been done on species previously known. The alphabetical arrangement renders it easy to look up any species, and the reference to the original paper, which is in all cases given, enables the information to be traced to the source. We regret to learn from the preface that the continuous strain proved too much for Prof. Dana, and his breakdown in health nearly three years ago compelled him finally to relinquish the work. Fortunately he had at hand a colleague, Prof. Ford, who was able to complete it for him. Lack of time, however, prevented the course, followed in the "System" and in the first appendix, of re-calculating from the data the crystallographical constants and the important interfacial angles being strictly adhered to.

The rate of discovery of new mineral species shows no sign of abatement, contrary to what might have been expected. The present volume includes about sixty definitely new species. It would, indeed, appear as if any careful search in new or little-known localities could not fail to be fruitful in bringing to light new species. Thus this volume includes descriptions of the interesting results of Dr. Flink's collecting trip to Greenland, many of Mr. Solly's remarkable discoveries in the famous Lengenbach quarry near Binn, the new mercury minerals from Terlingua, and the curious zinc phosphates from the Broken Hill mines, Rhodesia.

G. F. H. S.

OUR BOOK SHELF.

Principles of Reinforced Concrete Construction. By F. E. Turneaure and E. R. Maurer. Pp. x+429. Second edition, revised and enlarged. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 15*s*.

In this edition a considerable number of changes have been made, and much new material has been added. In every case records of experiments have been brought right up to date: this is especially the case in regard to the adherence between the concrete and the reinforcing metal, to the shear strength of beams, and to the strength of columns. The properties of concrete and steel are fully dealt with in chapter ii. The important question of the value of the modulus of elasticity of concrete is discussed in the light of the most recent experiments. The authors are of opinion that for most calculations in regard to strength the value of the modulus should be taken as 2,000,000 lb. per sq. in. The tests on bond by Mr. Withey seem to show that the intensity of the bond per square inch is not affected by the size of the bars, and that the average bond strength as determined by direct tension is much higher than in the case of beam experiments. The difficulty of carrying out these latter tests prevents their more usual adoption. In determining the strength of reinforced-concrete beams, the authors have wisely, for the greater part of the book concerned with this problem, assumed that the stress-strain curve for concrete is practically straight within the limits of the working stresses adopted in practice; in sections 60 to 70 they have, however, deduced a series of flexure formulæ on the assumption that the stress-strain curve is a parabolic arc. In both cases the concrete is assumed not to take any tension. Engineers engaged in structural work involving the use of this material for transverse loads can, therefore, check their results by both sets of formulæ, and thus secure an additional guarantee of the security of their design. Designers learn almost as much from the results of carefully conducted experiments as they do from all the formulæ that fill the various textbooks, and it is satisfactory to find a whole chapter devoted to a description and a discussion of a carefully selected series of rupture tests of both beams and columns.

In dealing with working stresses, the authors discuss the respective advantages and disadvantages of the "working stress" method, and the "factor of safety" method; they incline to the use of the latter in the present case. The whole question is discussed in a thoroughly practical and satisfactory manner in chapter v., especially from the point of view of economy. The last portion of the book deals with the design of reinforced concrete members, and the arrangement of connective details—floors, cross-beams, columns, footings, arches, and retaining walls are all treated in some detail, with numerous excellent dimensioned illustrations—and a complete chapter is given up to the design of chimneys. The fact that this book has already reached a second edition is a proof that it meets a want, and it is also a proof of the rapid spread of the use of reinforced concrete for all kinds of structural work. T. H. B.

The Influence of Heredity on Disease, with Special Reference to Tuberculosis, Cancer, and Diseases of the Nervous System. A Discussion opened by Sir W. S. Church, Bt., K.C.B.; Sir W. R. Gowers, F.R.S.; Dr. A. Latham; and Dr. E. F. Bashford. From the Proc. Roy. Soc. of Medicine, 1909, Vol. II. Pp. xii+142. (London: Longmans, Green and Co., 1909.) Price 4*s.* 6*d.* net.

This volume embodies an important discussion held by the Royal Society of Medicine, and, in view of the importance in determining the influence of heredity as an ætiological factor in the production of disease, the council of the Society has been well advised to publish it separately, as well as in its Transactions, and thus render it accessible to all.

Many eminent names appear and give the weight of their authority to the facts quoted. Sir W. Gowers, Dr. Savage, Dr. Mott, and Dr. Mercier dealt with heredity in connection with nervous and mental diseases; Dr. Latham and Dr. Bashford gave the opening addresses on heredity in tuberculosis and in cancer respectively; Sir John McFadyean dealt with the inheritance of disease among the domestic animals; Prof. Bateson and Mr. Mudge discussed the subject from the biological, and Prof. Karl Pearson from the biometrical, standpoint.

Mendelism naturally occupied a prominent place in the discussion, and great difference of opinion was expressed regarding it. For instance, Prof. Pearson states that "there is no definite proof of Mendelism applying to any living form at present; the proof has got to be given yet."

The pedigrees of many abnormal conditions given by various speakers seem to indicate that much further information is required before we shall be in a position to accept Mendelism, or indeed any other hypothesis of the laws of heredity. In fact, the main results brought out by this discussion would appear to be, first, that medical men and biologists should acquire a working knowledge of statistical methods; and, secondly, that for the next few years a careful collection should be made of pedigrees of abnormal conditions—such as albinism and night-blindness—so that eventually sufficient data may be acquired for proper analysis.

The Campaign against Microbes. By Dr. Étienne Burnet. Translated from the French by E. E. Austin. Pp. xi+248. (London: John Bale, Sons and Danielsson, Ltd., 1909.) Price 5*s.* net.

The author, in our opinion, has missed an opportunity for presenting to the general public an account of the present-day campaign against microbes and microbial diseases. Malaria, Mediterranean and enteric fevers, dysentery, diphtheria, and plague are not referred to, yet how much is now being done to mitigate the ravages of these human pestilences! On the other hand, one-fourth of the book is allotted to cancer, the microbial nature of which at present is, to say the least, discredited; and the essential preventive measures against this disease, so far as we know them, are omitted—*e.g.* the education of the public at once to seek medical advice if a tumour or swelling or abnormal discharge be noticed, and the immediate treatment of all forms of chronic irritation in and after middle life.

Tuberculosis, tetanus, sleeping sickness, enteritis and intestinal microbes, and small-pox and vaccination are the other subjects dealt with. As regards tuberculosis, a great deal is said about the vaccination of cattle, yet how little has this so far been applied practically? Tetanus, again, fearful as it is in individual cases, is not of much importance to the community as a cause of death. In the section on enteritis and intestinal microbes, the sour-milk treatment is rightly extolled, but to the exclusion of other matters, and the section on small-pox is mainly a history of Jenner's discovery. The book, therefore, while interesting and instructive so far as it goes, is disappointing, and seriously wanting as an exposition of the modern crusade against infective diseases.

The translator seems to have done his work well, but might in places have incorporated the results of recent research. R. T. Hewlett.

Brazil in 1909. By J. C. Oakenfull. Pp. 237. (Brazilian Government Commission of Propaganda and Economic Expansion. Paris, 1909.)

A country sixteen times the size of France, with a population barely half as numerous, a country teeming with mineral wealth, favoured with majestic river-systems, and climates capable of producing everything needed by man, boasting, too—at least on paper—a body of laws unsurpassed anywhere in their broadminded liberality—such is the theme Mr. Oakenfull has undertaken to expound. An immense undertaking, indeed, were it set out in all possible fulness of detail; but when compressed into some two hundred pages, requiring a tactful hand to give each subject its due space and no more. This task of selection has been carried out well. Publicists, financiers, miners, pastoralists, agriculturists, and tourists will all find their requirements catered for. The best chapters are those devoted to mineralogy and applied botany; but, as so often happens when the writer is not an expert botanist, a sad hash is made of some of the Latin names. For instance, *Cattleya amethyst oglobossa* is not in the "Index Kewensis," nor do botanists talk of *violaceas* or *bromeliaceas*. For his next edition Mr. Oakenfull should enlist the services of a botanist; he would also do well to revise his composition in places. Moreover, his account of the climate seems to us rather too optimistic; when the heat is moist, in Brazil as in all tropical countries, the conditions are apt to be very enervating. To the student of social phenomena the most interesting part of the book is that dealing with the rapid advances made under the Republic. The inducements to colonists, it may be added, are simply astounding in their liberality. S. M.

LETTERS TO THE EDITOR.

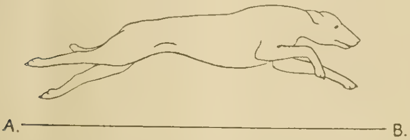
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Gallop of the Horse and the Dog.

In a note in Nature of October 28 (p. 526) it is stated that Mr. Francis Ram, in a recent book, says I am in error (in an article lately published by me) in regard to the position of the legs and feet in a running dog.

I have not seen Mr. Ram's book, but I should be glad if you will print the enclosed outline figure of a running dog taken from a series of instantaneous photographs of a running dog by Mr. Edward Muybridge.

The horizontal line AB gives the actual level of the ground below the dog. The figure is one drawn for a book which I have in preparation, and I think has considerable value, since it serves to establish my suggestion that the Mycenæans (who were the originators of the pose of the galloping horse, which was never used by Greeks, Egyptians, Assyrians, Romans, or Europeans, but travelled, as Salomon Reinach has shown, across Tartary to China and Japan, and came from Japan to England at the end of the eighteenth century) did not *invent* the well-known conventional pose, but *observed* it in the dog, and very reasonably, but incorrectly, *applied* it to representations of the horse and other animals which do not really assume that pose. The pose in question satisfies the artist's judgment even when applied to the horse, because the outstretched position of the hind legs, with upturned hoofs and the forward-reaching position of the fore-legs, do *succeed* one another in the galloping horse so rapidly as to cause, not a continuity of the retinal impressions, but a continuity of the more slowly formed mental appreciations of the positions of the legs.



It is an important fact that the late Prof. Marey, of Paris, did not succeed in photographing the dog with all the feet "off" the ground and the legs in the position shown in Muybridge's photographs, and consequently archæologists have supposed that the Mycenæans imagined the pose as an artistic expression of rapid galloping. It seems to me, on the contrary, certain that they constantly saw and admired this pose in their hunting dogs.

E. Ray Lankester.

29 Thurloe Place, South Kensington, October 29.

The Refractivity of Radium Emanation.

We have read with special interest the communication from Lord Rayleigh in Nature, October 28 (p. 519), on the determination of the refractivity of gases available only in minute quantity, because we ourselves have been working towards the same end at intervals during the last two years. Our object in view was also the same, viz. the determination of the refractive index of radium emanation; not only for the intrinsic interest of a knowledge of the refractivity in question, but also because of the great probability of the emanation being one of the series of non-valent elements, and the determination would therefore enable us to extend the series of simple integers which has been found by one of us to connect together the refractivities of the other elements in the series.

The extremely minute quantity of emanation available—not more, after undergoing the ordeal of purification, than about one-tenth of a cubic millimetre measured at atmospheric pressure—made it quite clear that the refractometer to be employed must be on a minute scale, and the form which it seemed to us would probably lead to the most accurate results in the circumstances was one on the principle of a Fabry and Perot *étalon*, partly on account of the sharpness of the bands thus obtainable and partly because it is the *double* thickness which constitutes the path difference between successive interfering beams, and consequently the gas contained is utilised twice.

A capillary tube of glass (or fused silica) was sealed at one end, and a transverse hole was drilled passing through the extreme end of the bore. Two parallel faces perpendicular to the axis of the hole were then ground on the tube, and parallel plates of glass (or silica), silvered (or platinised) on the inside, were then cemented on the faces with Coate's cement. For this apparatus we had recourse, as usual, to the excellent workmanship of Messrs. Hilger. The result was a tiny interferometer vessel, 2·271 millimetres long and 0·71 mm. diameter, into which we could compress the emanation through the capillary tube by means of a mercury column in the usual way. When this interferometer was set up in the path of the green beam separated spectroscopically from the light given by a Bastian mercury lamp, and the light passing through was examined through an astronomical eye-piece—the lens system throughout being chosen so as to give best illumination—the interference bands which were obtained were all that could be desired, it being easily possible—when the silvering was of the best thickness—to measure micrometrically to the hundredth part of a band.

The method of a determination, in general outline, consisted in alternately increasing and decreasing the pressure of the contained gas from and back to a practically zero value and observing the number of interference bands which passed over the cross-wire of the micrometer. In order to determine the efficiency of the arrangement, observations were made for the refractivity of air, with the result that we think we are justified in claiming that an accuracy to within about 2 per cent. could be relied upon, so far as the optical part of the experiments is concerned.

The real difficulties begin, however, when we deal with the emanation itself. The rapid generation of impurities, originating in part in the action of the emanation upon the resinous cement employed for fixing the parallel plates, together with the lack of a knowledge of what these impurities are, made it impossible to calculate the index of the emanation from the experimental results, although it was perfectly easy to measure the refractivity of the mixture of gases existing at any time. The only datum known in regard to the composition of the mixture was the approximate percentage of emanation present, this being found by measuring the γ radiation from it. The direction in which the refractivity lies may, however, be inferred with probability from the following observations. Starting with emanation given off from a solution and containing a very large amount of impurity, this was purified, first, by explosion, drying, and absorption of CO_2, and afterwards by freezing in liquid air and pumping off the volatile impurities according to well-known methods. Testing the refractivity from time to time, its value—at first of the order of that of air—did not sensibly rise until the volume was about one cubic millimetre. Continued purification increased the refractivity, and the highest values obtained in our experiments were 0·000840 when the volume was 0·205 mm.^{3} (at atmospheric pressure) and 0·000916 when the volume was 0·128 mm.^{3} measured at atmospheric pressure. The quantity of emanation was approximately the same for both these measurements, and equalled the quantity in equilibrium with 0·178 gram of radium. Of course, if we could assume that the impurities were the same in kind on the two occasions it would be possible to estimate from these data the value for the pure substance, but the failure of this method on many occasions to give consistent results took away all belief in its applicability. For purposes of comparison we may state that the higher of the above values is about twenty-six times the value for helium, while the value for xenon—the highest for any known gaseous element—is twenty times, and for CO_2 thirteen times, the value of helium.

One source of difficulty so long as the available amount of emanation is so small is that the maximum pressure to which it can be raised in the apparatus is only a few (7 or 8) centimetres. The capillary correction thus becomes exceedingly important, and Sir W. Ramsay has given reasons for believing that the capillary behaviour of mercury is quite abnormal in the presence of emanation. Another serious difficulty with which we had to contend was that, under the action of the emanation, the silver (or platinum) through which the light had to pass gradually became opaque. The consequence was that the apparatus had each time to be dismounted after a couple of days, the faces re-polished, re-silvered, and re-installed before a new experiment could be begun. This source of inconvenience would, of course, not be present in apparatus similar to the Young-Arago method employed by Lord Rayleigh or in a Jamin refractometer (which we think is the more satisfactory of the two), but we do not think that it would be possible to obtain an equal optical efficiency with these arrangements.

The amount of success attending these experiments—small though it may seem to be—justifies us in hoping that if the amount of available emanation were increased a few times only an approximate value of the refractivity would be ascertainable. Even at the present time this might be effected by means of a collaboration amongst all those in the United Kingdom who possess large quantities of radium.

In conclusion, we desire to express our thanks to Sir W. Ramsay for generously supplying us with the emanation with which these experiments were made.

Alfred W. Porter.
Clive Cuthbertson.

Physical Department, University College, London,
November 1.

Atmospheric Cloudy Condensation.

In Nature of October 21 Sir Oliver Lodge, writing on the recent magnetic storm, seems to think that during these storms the sun is emitting electric projectiles which cause the magnetic disturbance, and that these projectiles will, at the same time, affect the rainfall by the influx of "cosmic nuclei." From this, I presume, Sir Oliver means that the electrons passing through our atmosphere will produce ions in the air, and that these ions will become nuclei of condensation, and in this manner may increase temporarily and locally the rainfall. Now, so far as is at present known, it does not seem probable that these electrified nuclei play any part in cloudy condensation. That they can become centres of condensation is not doubted, but before they can act in that way the atmosphere has to become very highly supersaturated.

These ions, therefore, cannot play any part in the condensation unless all the dust in the air be first removed. The question thus becomes, Is there such a thing as dust-free air in our atmosphere? So far as I am aware, no such condition has ever been observed. I have returns of observations made in many parts of the world by different observers, as well as by myself. Some of these tests were made while crossing the Atlantic Ocean, others on the Pacific Ocean. Many were made in this country and in different countries on the Continent. Some were made at sea-level, others up to an elevation of 13,000 feet, but none of these records shows anything like dustless air. Mr. Rankin, in his Ben Nevis report, says "any number less than 100 particles per cubic centimetre is phenomenally small." Mr. E. D. Fridlander, at an elevation of more than 13,000 feet on the Bieshorn, found 157 particles per c.c. In many hundreds of observations made by myself on the Rigi Kulm (6000 feet) nothing quite so low as 200 per c.c. was ever observed. The reports of the observations made on the oceans show the dusty air to be everywhere, and there does not seem to be much chance of ever finding dustless air, at least so low as cloud-level, as the air with least dust is not found in the descending currents of anticyclones, but in the cyclonic areas, where the air is well washed by the rains. It may be further stated, in connection with this subject, that there is no reason for supposing that an increase in the number of nuclei would have any effect on the rainfall, as in nature only a few of the nuclei do all the condensation, while the others remain inactive.

This letter may seem longer than the subject warrants, but my reason for entering so fully into the subject is that the idea is now very generally accepted that ions do form the nuclei of cloudy condensation in our atmosphere. So stereotyped has this theory become that there is not a scientific book recently published in which this subject is treated which does not give this view. Now, so far as our knowledge at present goes, there is no support for this theory, and those who advocate it will require to show that there is ever dustless air at cloud-level. I have elsewhere shown that, even supposing there was dust-free air, clouds would not likely be formed, but the supersaturation would be relieved by the direct formation of rain, as the condensation in the highly supersaturated air would take place on only a few nuclei, which would grow very rapidly to rain-drops.

It is not here contended that the passage of the electrons through our atmosphere will have no effect on the rainfall, only that it has not been shown that there are ever the conditions necessary for the ions so formed to act as nuclei of cloudy condensation. That the electrons may act in some way in determining the coalescence of cloudy particles to form rain-drops seems possible, but, so far as I am aware, even this has not been demonstrated.

Ardenlea, Falkirk. John Aitken.

Magnetic Storms.

J'ai lu avec le plus grand intérêt dans le No. 2083 de ce périodique la note importante de M. le docteur Chree sur la dernière grande perturbation magnétique du 25 septembre, 1909.

Comme je fais depuis 1882, j'ai cherché de la mettre en relation avec le passage de la grande tache solaire australe qui a été observée, dessinée et relevée à l'observatoire de Catane par l'assistant M. L. Taffara tous les jours depuis l'apparition au bord est le 18 septembre jusqu' à la disparition au bord ouest le 29 septembre, excepté les jours 19 et 22, où l'observation a été empêchée par les nuages.

De nos observations il resulte que la tache doit être passée par le méridien central le 23 septembre, environ à 5h. soir, temps moyen de Greenwich.

Dans la relation de M. Chree n'est pas donné le temps du maximum de la perturbation, parceque les oscillations des appareils magnétiques de l'observatoire de Kew étaient souvent plus amples de ce que pouvaient être enregistrées. En considérant le commencement et la fin des oscillations plus amples, on a les temps 11h. 43m. et 8h. 30m. et la moyenne 4h. 7m.

Si l'on fait la différence avec le temps du passage de la grande tache, c'est à dire sept. 25, 4h.–sept. 23, 5h.= 1j. 23h.=47h., on a le retard de la perturbation magnétique sur le temps du passage de la tache à la moindre distance du centre du disque solaire, c'est à dire à la moindre distance de la droite qui unit le centre du soleil à la terre.

Ce retard est très peu différent de celui de 45½h. que j'ai trouvé en moyenne pour 8 coïncidences de passages de grandes taches avec le maximum de fortes perturbations magnétiques du premier semestre 1892; ce retard aussi n'est pas trop différent de celui de 42½h. que j'ai trouvé entre le temps moyen du commencement et de la fin de 19 grandes perturbations magnétiques et le temps des passages de grandes taches, ou de grands groupes de taches, d'après les relèvements de M. Maunder de l'Observatoire de Greenwich.

Il serait donc confirmé aussi pour cette grande perturbation magnétique un temps de 40 à 50 heures pour la propagation du soleil à la terre de l'influence ou action solaire sur le magnétisme terrestre; ce qui donnerait une vitesse de 900 à 1000 km. par seconde; c'est à dire une action plus que 300 fois moindre de celle de la lumière et des actions électromagnétiques. Mais cette vitesse pourrait bien être celle des particules émises par le soleil, selon les idées de M. Arrhenius.

Ainsi l'hypotèse corpusculaire de l'influence solaire acquiert toujours une plus grande probabilité.

L'assistant M. le Dr. Horn a fait à l'Observatoire de Catane presque à tous les jours du passage de la grande tache les photographies au spectrohéliographe, mais on n'a pas obtenu autour de la tache des très-grandes masses faculaires. A. Riccò.

Catania, October 10.

High Pressure Spark Gap in an Inert Gas.

FOR some years I have employed a high-pressure spark-gap, such as that described by me in the *Phil. Mag.* for August, 1902, in connection with a Tesla inductive system, and I have experienced considerable trouble arising from the erosion of the spark balls and their supports. They soon become coated with an oxide of the metal employed, and the sparking becomes unsteady. As a cure for this evil, which contributed much to the formation of a bad type of spark, the employment of some inert gas suggested itself to me; and of such gases Mr. C. C. F. Monckton proposed the use of nitrogen, and this gas I now use instead of air. I find that after the continuous use of nitrogen in the spark-gap the balls are but little affected, while the spark through a gas pressure of 50 lb. per square inch is compact and constant in shape, and the yield of the induction apparatus is greatly enhanced. The spark-gap globe is filled to the required pressure from the gas cylinder through a reducing valve, and when it is shut off the pressure is maintained for ten or twelve days nearly up to the initial one.

The nitrogen, which was supplied by the British Oxygen Co., compressed in a steel cylinder, turned out to be very nearly pure; it is separated from liquefied air, and is certainly more pure than hydrogen as supplied in cylinders, and gives better results. The spheres are made of thick white glass, and are tested to about four times the load they are worked under. The spark ball is advanced by means of a fine screw forty-eight threads to the inch, cut on ¼-inch rod, working in a boss which forms a part of the gun-metal cap with which the glass globe is closed. If the screw is carefully fitted by Whitworth screwing apparatus, no gland or stuffing-box is required. The screw is slightly lubricated with a mixture of equal parts of pure india-rubber and vaseline. The length of the spark is measured by means of a divided head attached to the screw.

It might be supposed that a long spark in air at normal pressure would have the same effect as a spark shortened by gas pressure; but experimental evidence shows that the thick, steady, well-formed spark made under pressure gives far the most trustworthy results. Sparks made in air at normal pressure often do not strike from the nearest surfaces, but strike along an arched path, this effect reducing the discharge and rendering it variable in its intensity; but when the high-presseure nitrogen spark-gap is employed, the discharge from the Tesla apparatus is steady and unvarying during periods of time such as forty or sixty minutes.

F. J. JERVIS-SMITH.

The Small Motion at the Nodes of a Vibrating String.

IT is generally recognised that the nodes of a string which is maintained permanently in oscillation in two or more loops cannot be points of absolute rest, as the energy requisite for the maintenance of the vibrations is transmitted through these points. I have not, however, seen anywhere a discussion or experimental demonstration of some peculiar properties of this small motion. A brief note may therefore be of interest.

In the first place, the small motion at the node is in a phase which is different from that of the rest of the string. The exact difference of phase is shown by a dynamical investigation to be a quarter of an oscillation. The motion is of very small amplitude, and it might therefore be thought a difficult matter to verify this experimentally. I have, however, devised some convenient arrangements with which this can be effected. I shall here mention only one method: this was to compound the oscillation at every point on the string with another perpendicular to it of half the frequency, and to observe the compound oscillation at the nodes and elsewhere.

Such a compound oscillation can easily be maintained permanently by having the string attached to the prong of an electrically maintained tuning-fork, so that it lies in a plane perpendicular to the prongs, but in a direction inclined to the line of their vibration. When the load on the string is slightly greater than that necessary for the most vigorous maintenance, points on the string describe parabolic arcs with concavities in opposite directions in alternate loops, the whole forming a beautiful and interesting type of stationary vibration. This is not, however, the stage convenient for observing the small motion at the nodes. When the tension of the string is relaxed, so as to make its vibration stronger, points on the string, *i.e.* except the node, describe 8 curves. The curve described by the node is neither a straight line nor an 8 curve, but is a very flat parabola. From this, the phase-relation between the small motion at the nodes and the large motion elsewhere is obvious.

If the node has a small motion, then, strictly speaking, there is no node at all. There should, however, be points at which the positions of the string in opposite phases might be supposed to intersect. One might suppose that these points, or "fictitious nodes," should execute a very small, almost microscopic, movement. As a matter of fact, these "fictitious nodes" oscillate parallel to the string through a range equal to the whole length of a loop. This somewhat striking effect may be observed without difficulty by illuminating the string with periodic illumination of twice the frequency of the oscillation.

Post-Box 59 Rangoon. C. V. RAMAN.

An Instance of Prolonged Pupation.

THE following facts in connection with a specimen of the privet hawk-moth may possibly be of interest to some of your readers.

The caterpillar, which was reared from the egg at Tunbridge Wells, pupated between August 7 and 9, 1906, and the pupa was sent out to me by post. The moth did not emerge until October 16, 1908, having been more than two years in the pupal state. Being the only specimen I have, I cannot say whether it shows any variations; but it is not stunted, measuring just over 4 inches across the expanded wings.

GEO. H. WYLD.

Sydney, N.S.W.

A SCIENTIFIC MISSION IN ETHIOPIA.[1]

ABYSSINIA—and even in a more general way the whole Empire of Ethiopia—though it was the first portion of tropical Africa to come within what one might term the scientific cognisance of the civilised world, the world of Mediterranean Europe and Western Asia, remains, nevertheless, to this day the least understood and one of the most imperfectly explored parts of Africa. In all probability, more is known about the fauna, the flora, the human races, and languages of even the most recently revealed recesses of the Congo Basin, of the Central Sudan, the Liberian hinterland, and the south-western part of the Niger Basin (to mention some of the least-known parts of tropical Africa) than is recorded of the dominions of the Emperor Menelik.

This ignorance of Ethiopia (from the point of view of modern science) is, of course, proportionately estimated in relation to the extraordinarily important position all this region occupies in the study of Africa, in the solution of African enigmas. It is an area of about 200,000 square miles, containing exceptionally high mountains, the tops of which, but for the increasing aridity of North-East Africa, should be even more covered with glaciers than is the case with Ruwenzori, under the Equator, for the Ruwenzori range only exceeds in altitude by a few hundred feet the estimates of the highest points of northern and south-western Abyssinia. In Abyssinia alone, of all parts of tropical or Trans-Saharan Africa, may distinct evidences be found of the existence (on the high mountains and even in the plains) of a Eurasian fauna and flora—wild swine of the genus Sus, wild goats, wild dogs (*Canis simiensis*), and a few other beasts and a number of birds, trees, and plants, which in their affinities belong more truly to the Palæarctic and subtropical regions of Europe and Asia than to true Africa. There are also indigenous non-Negro races, like the Gala, which, by skull formation, by their use of the plough (absolutely unknown elsewhere in Negro Africa), by their languages, and many other points, are Asiatic rather than African.

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[1] "Mission en Éthiopie (1901–3)." By Jean Duchesne-Fournet and others. Tome i., pp. xviii+440; Tome ii., pp. xv+388, and atlas. (Paris: Masson et Cie., 1909.)

Yet there are indications that Abyssinia, like Somaliland, Egypt, Mauretania, has been inhabited by man from a most remote period. Abyssinia may have been the first great focus of *Homo sapiens* on the African continent, to the south of the Sahara Desert; the region from which radiated Pygmies, Bushmen, Nilotic Negroes, Forest Negroes, and Bantu; Hamite, Egyptian, and the widespread negroid types typified by the modern Fula, Hima, Nyam-nyam, and Tibbu. Here took refuge an ancient offshoot of the Jewish people; here first of all with the armies of Ptolemy, was carried Greek civilisation into tropical Africa; hither came Persians after they had conquered southern Arabia; even more anciently than Jew or Persian a branch of the Semitic peoples was implanted in Abyssinia, which has left behind to this day at least two distinct language-groups of the Semitic family—Amharic and Harrari—in addition to the much later Arabic.

Here we are in one of the few portions of tropical Africa known to the Romans and to the civilised kingdoms of India before the time of Christ. (*Habshi*—derived from *Habesh*, an old Semitic name for Abyssinia—is even at the present day the common word for *negro* throughout Hindustan, and is also equivalent to "magician," because in the ancient lore of India, Abyssinians were identified with all the unholiest forms of magic. They are the "black magicians" of the "Arabian Nights'" stories. When the present writer first imported Sikh soldiers into Central Africa to fight the Arab slave traders, brave as they were in the presence of Arabs, they were at first frightened of the friendly negroes. "He is a Habshi, and will turn me into a rabbit," said one stalwart Sikh soldier to me when I asked him to travel alone through the bush with a negro guide.)

The Portuguese soldiers and missionaries first revealed some marvels of Abyssinia and Ethiopia to the modern European world of the later Renaissance. The Portuguese also, by splendid feats of arms, saved Christian Abyssinia from being conquered and effaced by a great army of Arabised Somalis under Muhammad Granye. Then came an interval of Abyssinian distrust of the greedy white man, and the attempts of Louis XIV. to supplant the Portuguese and frenchify Abyssinia in the seventeenth and eighteenth centuries led finally to great disasters, though it increased the acquaintance of the European world with these profoundly interesting countries. After that came the awakening of British interest through the travels of Bruce and Salt. The last named (Henry Salt) added considerably to our knowledge of the peculiar fauna of these countries.

During the first half of the nineteenth century, French interest in Abyssinia had a notable revival, and to the brothers D'Abbadie (of French-Irish origin) we owe much of our meagre knowledge of the Hamitic and negroid dialects of western Abyssinia and south-west Ethiopia. After this came British big-game hunters, consuls, and, finally, an army of British and Indian soldiers. Mr. W. T. Blandford, amongst other notabilities in zoology and geography, accompanied this expedition, and again revealed further remarkable features in the mammalian fauna of this peculiar part of Africa.

We have learnt a little more since from British and Italian missionaries and explorers (notably, as to fauna, from Major Powell Cotton), but more still from French expeditions, important among which have been those of the late Baron Carlos d'Erlanger and Baron Maurice de Rothschild.

One of the most remarkable French expeditions (not forgetting the work of Borelli some sixteen years ago) lately undertaken for the examination of Abyssinia and Ethiopia, is that which is the motive and the source of the present notice.

In a rather too intimate and emotional preface to this work, addressed to the father of Jean Duchesne-Fournet, we are told that this young and brilliant French explorer died in 1904, after his return from Abyssinia. In the course of his journeys he had reached the Wallaga country during the rainy season, and had suffered to a terrible extent from fevers, the sequelæ of which caused his death after his return to France. He was, in fact, a martyr to science, for the Wallaga country is a very little known part of East-Central Africa, lying to the south of the Blue Nile and of the Didessa River, and at no great distance from the frontier of the Egyptian Sudan.

The special object of Duchesne-Fournet's exploration of Wallaga was its reputation, not only as a possible source of future wealth in gold, but as a region from which gold was obtained in the distant past for the ancient Egyptians. Apparently a concession had been granted in that region to a French syndicate, and an active exploration was being carried on by a French engineer, Monsieur Comboul (who afterwards died). The Wallaga country has a mean elevation (averaging the French and Italian calculations) of about 6000 feet. It seems to have been visited by Jean Duchesne-Fournet alone (with an Algerian escort), or, at least, without any one of the French men of science on his staff, consequently, from the point of view of science, his incursion into this south-westernmost portion of the Emperor Menelik's dominions had little results of importance. He describes this country as "ravissant surtout avec sa belle verdure." It has a certain amount of woodland, rare elsewhere in the Abyssinian Empire. The rainfall is extremely heavy, and the country to a great extent lies within the basin of the River Didessa, an important southern affluent of the Blue Nile. It is covered with a luxuriant vegetation, and, where there is any agriculture (the land is inhabited sparsely by Galas and Walamo negroids), wheat, barley, maize, sorghum, beans, peas, potatoes, coffee, limes, bananas, and cotton are cultivated. The engineer Comboul seems to have found deposits of lignite, the importance of which was appreciated by the Emperor Menelik. But although in beauty this region was a paradise, and in products one of the richest parts in Africa, the climate seems to have been singularly unhealthy—constant fevers, not to be explained easily under the mosquito theory of infection, and terrible rheumatisms made its exploration during the rainy season almost a torture. Some of the great mountains (the summits of which would seem to reach here and there to 10,000 feet) contained immense caves, the exploration of which might yield important results in palæontology and palæanthropology.

The premature death of the leader of this expedition (the other members of which were Lieutenant Collat, Sergeant-Major Fontenaud, Louis Lahure—who afterwards greatly distinguished himself in explorations between the Benue and Lake Chad—H. Arsandaux, Dr. Goffin, and Dr. Moreau) to some extent spoilt the realisation of the full scientific results; as it is, the material collected and presented in the two volumes and the atlas of this book, give us, first of all, a most important *aperçu géologique* of the Danakil country, French Somaliland, and southern Abyssinia as far as Addis-Abeba, and a petrographical study of the same regions, with analyses of the rocks and minerals collected, and many photographs to show the types of landscape. These photographs are most conscientious, but the country presented to our eyes between Addis-Abeba and the Gulf of Aden is certainly one of the least alluring of all Africa. The Sahara Desert is much more attractive from the painter's point of view.

Some beetles were collected and are described. There is a most important article (taking up a considerable proportion of the second volume) on the anthropology and ethnography of southern Abyssinia, by Dr. R. Verneau, of the Paris Museum of Ethnography. This is accompanied by admirable photographs of skulls, of clothing and adornments, of musical instruments, pottery, jewellery, and horse harness; but the photographs taken by the expedition of living human types are, with one or two exceptions, not good or trustworthy, since they have been too much touched up in order to make them presentable pictures, or else they are very minute. The author of this section (Verneau) would seem to have arrived at the following general conclusions:—That in the portions of Abyssinia and northern Ethiopia in which the Duchesne-Fournet expedition collected skulls and took careful measurements of the living body, there were, besides the pure-blooded Negro, three distinct human types:—(1) The *Amhara* or *Abyssinian* (with which might also be grouped the *Gala*; (2) the *nigritised Abyssinian* (simply the result of ancient and modern intermixture between the Hamite—Abyssinian, Gala—and the Negro); and (3) a most interesting form, the *Berber* (this is a short title for the descriptive term given by Dr. Verneau, who calls it, "Type Abyssin clair, à cheveux lisses ou ondulés," and elsewhere, "Berbère"). This "third ethnic element" he describes as "very different from those which I have already set apart." It is one which has made its influence felt in Abyssinia, but, like the Negro element, it has crossed with the Hamite or Ethiopian (type No. 1), and as the result of this mixture its characters have become sensibly attenuated. "Nevertheless, one may affirm that this type No. 3 is of a fair complexion, slightly *cuivré*, and is further notable because it has evidently lightened the complexion of the skin in 13·5 per cent. (approximately) of the actual population." "Type No. 3," he goes on to say, "has blue eyes, or must have had blue eyes originally; for one could scarcely derive the blue, grey, or green iris (which is that we have noted in the proportion of 11·7 per hundred amongst modern Abyssinians) from the Ethiopian or the Negro. It is also type No. 3 which has certainly introduced the smooth or very slightly undulating hair, which has been found in 13·2 per cent. of the individuals under examination. On the other hand, this light-skinned race has not introduced tall stature amongst the people, but rather lessened the stature of the Abyssinians as compared with that of the Hamite and negroid races farther south."

In this race, Dr. Verneau apparently sees a marked resemblance to the Kabail of Abyssinia. One of the skulls depicted seems to display affinities with the Cro-magnon race of Western Europe.

There is a most comprehensive bibliography of Ethiopia in this work under review, a work which whets one's appetite for a complete examination of Abyssinia.

H. H. JOHNSTON.

THE SYSTEMATIC MOTIONS OF THE STARS.[1]

A SYSTEMATIC character in the proper motions of stars was discovered by Herschel, and accounted for by the motion of the solar system in space. Herschel's conclusions were for a time disputed by Bessel, but were confirmed by Argelander, and have since been generally accepted. In the last quarter of a century many determinations of the direction of the solar motion have been made, but the results have not shown that accordance which might have been anticipated. Particularly noticeable are the different results obtained from the proper motions determined by Auwers of the stars observed by Bradley in 1750, and re-observed about 1860, according to the method employed. Applied to these stars, the mathematical methods of attacking the problem developed by Airy and Argelander place the solar apex, or point to which the sun is moving, in declination +35° or thereabouts, while Bessel's method places it at −5°. In 1895, Dr. Kobold directed attention to these discrepancies, which seem to point to an error in the fundamental hypothesis underlying these methods of determining the direction of the solar motion. These methods are based on the assumption that the "peculiar" motions of the stars are haphazard, and have no preference for any particular direction or directions in space.

As an outcome of prolonged study of the subject, Prof. Kapteyn announced, in 1905, at the meeting of the British Association in South Africa, that this hypothesis was untenable. He used the well-determined proper motions of 2400 stars extending from the pole to 30° south of the equator given in Auwers-Bradley. Dividing this area of the sky into twenty-eight regions, he determined the directions of the apparent proper motions of the stars in each region, and found that they showed a preference for *two* special directions and not for one only. When these favoured directions for the twenty-eight areas were plotted on a sphere, they were seen to converge to two points. Convergence to a point on the sphere indicates that the apparent linear motions of the stars are parallel, just as the radiant point of a meteor stream indicates the direction in which the meteors are all apparently travelling. Relatively to the sun, therefore, the stars are moving in two streams, inclined at a considerable angle to one another; these motions are apparent only, and, when the solar motion is subtracted, are resolvable into two streams moving in diametrically opposite directions, relatively to the centre of gravity of the stars. Kapteyn showed that the stars were equally distributed among the two streams, and that their relative motion was in a line in the plane of the Milky Way, directed towards the star ξ Orionis (R.A. 91°, decl. +13°) and the opposite direction. The apparent motions of the stars are thus resolvable into a combination of (1) a haphazard motion, (2) the reversed solar motion relative to the centre of gravity of the stars, and (3) the stream movement in the direction of ξ Orionis and the opposite direction. It was pointed out by Kapteyn that the determinations of the solar motion made by Airy's method, the one most generally adopted by astronomers on account of its simplicity and convenience, were not much in error, in spite of the systematic character of the motion of the stars in these two streams. For the equations which result from Airy's method agree closely with those of a valuable method of determining the solar motion due to Bravais, which does not assume the haphazard character of the peculiar motions of the stars. But an entirely new fact in stellar astronomy has been elicited in the discovery of the systematic movements towards and away from ξ Orionis.

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[1] (1) J. C. Kapteyn, Reports of the British Association for the Advancement of Science, 1905, p. 257.

(2) A. S. Eddington, Monthly Notices of the Royal Astronomical Society, 1906, vol. lxvii., p. 34, and vol. lxviii., pp. 104 and 588.

(3) K. Schwarzschild, Nachrichten von der Königlichen Gesellschaft der Wissenschaften zu Göttingen, 1907, p. 614, and February, 1908.

(4) S. Beljawsky, Astronomische Nachrichten, Band clxxix, p. 293.

(5) F. W. Dyson, Proceedings of the Royal Society of Edinburgh, 1908, vol. xxviii., part i., p. 231; 1909, vol. xxix., part iv., p. 376.

Mr. Eddington introduced a precise mathematical definition in place of the somewhat nebulous phrase star-stream. A "drift of stars" is defined as a group of stars the velocities of which relative to some system of axes are quite haphazard. The velocity of the "drift" is the velocity of the system of axes, while the "peculiar" velocity of a star is its haphazard velocity relative to the system of axes. Haphazard is defined as a distribution of velocities, according to Maxwell's law for the molecules of a gas. Formulæ are then developed to give the distribution of the directions of proper motions in any small area of the sky which would arise from the projection on the face of the sky of a star drift with a given mean peculiar velocity and a "drift" velocity given in magnitude and direction. Mr. Eddington applied his method to the consideration of the proper motions in Groombridge's catalogue, recently determined at Greenwich by Messrs. Dyson and Thackeray. The catalogue contains about 4500 stars within 52° of the North Pole, a large proportion being between magnitudes 7 and 9. Comparing the actual distribution with a theoretical one, based on the assumption that the stars form two drifts, he found close accordance. The stars were equally divided between two "drifts" the apparent directions of which were in good agreement with Kapteyn's results. The two streams did not show any distinctive features, each contained bright and faint stars, and stars of all types of spectrum, and, further, the mean distances from the sun of the stars contained in the two "drifts" were the same. Additional confirmation was obtained from 1200 stars within 10° of the North Pole, the proper motions of which had been determined by comparison of the Greenwich positions in 1900 with those found by Carrington in 1855. In a later paper, and by a somewhat different method, about 2000 fairly bright zodiacal stars were also examined.

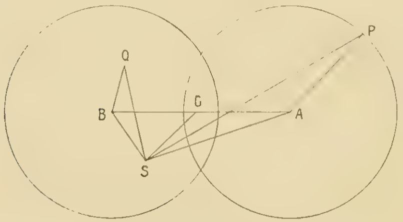

FIG. 1.—Velocity diagram according to Eddington's hypothesis.

According to Mr. Eddington's determination, the velocity of one stream relatively to the sun may be represented by SA, and that of the other by SB, while the haphazard velocities of the stars composing the streams are equally in all directions from the centres A and B, and their mean values are represented by the radii of the two spheres. The solar velocity relative to the centre of gravity of all the stars is represented by SG, and the rates at which the streams are separating by AB. If SP denote the velocity of one star relatively to the sun, this may be analysed into SA, the "drift" velocity, and AP, the "peculiar" velocity (which in this instance has its mean value); the drift velocity SA may be analysed into SG, the solar motion, and GA, the velocity of the stream. Similarly, SQ, the velocity of another star, may be resolved into a component of the second stream, the peculiar velocity of which is BQ, or only half the mean value.

Prof. Schwarzschild assumes that the "peculiar" motions of the stars do not obey Maxwell's law, but a slightly modified law in which the resolved parts of the velocities in one direction are all increased in a definite proportion, thus giving a spheroidal instead of a spherical distribution. When combined with the solar motion, this distribution of "peculiar" velocities gives two favoured directions for the proper motions of the stars included in any small area of the sky, and has the advantage of representing the stars as a single instead of a dual system. Applied to the Greenwich-Groombridge proper motions, the assumption shows a very satisfactory accordance with facts. According to Prof. Schwarzschild, the observed proper motions of these stars would be produced by a velocity of the solar system SG and "peculiar" velocities of the stars the mean values of which in different directions are radii of the prolate spheroid ABA′B′. Thus the velocity SQ of a star is resolvable into SG, the solar motion, and GQ, the "peculiar" velocity. In this instance the "peculiar" velocity is one-half the mean "peculiar" velocity belonging to the direction GQ. In his second paper Prof. Schwarzschild develops his theory with great mathematical elegance so as to make it applicable to cases where the number of stars per unit area is small. In this form it is applied by Mr. Beljawsky to the stars of large proper motion in Prof. Porter's catalogues, although its application is not free from objection, as these stars were selected on account of their large proper motion, while the method is strictly only applicable to unselected proper motions.

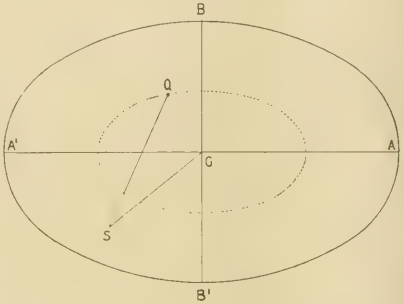

FIG. 2.—Velocity diagram according to Schwarzschild's hypothesis.

Prof. Dyson collected all the proper motions greater than 20″ a century from various sources, and by a simple graphical method determined the favoured directions of motion. Partly owing to the small effect of accidental error of observation on the direction of the proper motion of these stars, and partly because only large proper motions were considered, the two apparent star streams were shown with great clearness. In the large majority of cases it was possible to assign individual stars to one or other of the two streams, and thus a verification was obtained of the result that the two streams showed no difference as regards the magnitude or type of spectrum of the stars in them. Of 1800 stars examined, 1100 belonged to the first stream, 600 to the second, and the remaining 100, which could not be assigned to either, showed no motion of a systematic character. The large proportion of stars belonging to the first stream arises from the mode of selection according to the magnitude of proper motion. Kapteyn's and Eddington's result, that when stars are taken without selection they are equally divided between the two streams, is used to determine the ratio of the stream velocities. When this is determined the apparent movement in two streams, as seen from the earth, is replaced by the solar motion and two streams moving in opposite directions relative to their centre of gravity.

There is at first sight considerable difference between Kapteyn's description (followed by Eddington and Dyson) of the systematic movements of the stars, and that of Schwarzschild. The dual character of Kapteyn's system should not be unduly emphasised. Division of the stars into two groups was incidental to the analysis employed, but the essential result is the increase of the peculiar velocities of stars towards one special direction and its opposite. It is this same feature, and not the spheroidal character of the distribution, which is the essential of Schwarzschild's representation. The results obtained by the two methods agree very closely. Defining the "apex" as the direction of the sun's motion relative to the centre of gravity of the stars. and the "vertex" as the direction of motion of one stream relatively to the other (Kapteyn) or the major axis of Schwarzschild's spheroid, the accordance of the different results is shown in the following table:—

	Apex R.A. Dec.	Vertex R.A. Dec.
Kapteyn—Bradley stars	— ...	91 + 13
Eddington—Groombridge stars ...	266 + 31 ...	95 + 3
Schwarzschild—Groombridge stars ...	266 + 33 ...	93 + 6
Dyson—Stars of large proper motion.	281 + 42 ...	88 + 24
Beljawsky—Porter's stars	281 + 36 ...	86 + 24
Eddington—Zodiacal stars	— ...	109 + 6

It may be noticed that the Groombridge stars gave almost identical results by the methods of Eddington and Schwarzschild, and that Beljawsky and Dyson, whose material was very similar, obtained results in close accord.

Although attention may be directed to Kapteyn's observation that the vertex lies in the plane of the Milky Way, it is too soon to offer any explanation of these remarkable movements of the stars. To have disentangled them from the irregular proper motions of the stars is itself a very important step. By clearing up the difficulty in the anomalous results previously found for the direction of the solar motion, and by the discovery of systematic movements in which all the stars share, Prof. Kapteyn has made the most important contribution to this branch of astronomy since the time of Herschel.

F. W. DYSON.

THE SEA OF ARAL.

RECENT explorations in Central Asia, and the evidence accumulating from many quarters of general desiccation of that area within historic times, give special interest and value to anything in the shape of observations of even approximate precision which point towards an opposite conclusion, or to a conclusion that variations in the amount of precipitation, where they occur, are more or less local and constitute merely a phase which, although it may be of relatively long period, does not represent continuous progressive change. The work carried on by L. S. Berg in the Sea of Aral between the years 1900–1906 form an important contribution to the subject of limnology generally, and more particularly to this question of desiccation. The original report on these investigations (Berg, "The Sea of Aral," St. Petersburg, 1908) is published in Russian, but students unfamiliar with that tongue may acquaint themselves with the present state of knowledge concerning the whole region by means of an article by Prof. Woeikow, published in the April number of *Petermann's Mitteilungen*. Prof. Woeikow deals primarily with Berg's observations, and his maps are reproduced, but he uses information derived from other sources, for purposes of comparison.

The Sea of Aral is situated at an elevation of 50 metres above mean sea level, and its area of 63,270 square kilometres places it fourth in size amongst the inland lakes of the world. The mean depth is 16 metres, and the maximum 68 metres, depths exceeding 30 metres occurring only in one small depression in the west and two still smaller ones in the north of the basin. The volume of water is computed to be 1012 cubic kilometres, only slightly greater than that of Lake Ladoga, which has about one-quarter of the superficial area, and about one-tenth of Lake Baikal, which is little more than half the size. The supply of water comes wholly from the two rivers Amu and Syr, which together deliver, on the average, some 1500 cubic metres per second. Most of the water is derived from the melting of mountain snows, the months of maximum flow being June, July, and August. Berg gives the mean salinity as 10·75 *pro mille:* compared with analyses made during the 'seventies of last century, which yielded an average of over 12 *pro mille,* this shows a marked freshening, due, as appears, to an increased volume of water.

The survey of the Sea of Aral by Admiral Butakow in the late 'forties formed the first foundation of accurate knowledge, and there is evidence to show that at the time of that survey the level of the water was relatively high. Few precise measurements were made for a long time afterwards, but it seems certain that after the 'forties a period of falling level began, and continued for some thirty to thirty-five years. Borczow reported diminishing area in 1857. The period 1859 to 1874 is blank, or nearly so. Sewertzow, Subow, and Kaulbars (1873–4) found great shrinkage on comparison with Butakow's survey, and further comparison with the records of Meyendorff and Ewersman (1820) seemed to justify the conclusion that a general desiccation of this part of Central Asia was taking place continuously. K. Schulz, surveying in the north-eastern end of the sea in 1880, found still further shrinkage since 1874.

From 1880 to 1899, when Berg first visited the region, another blank occurs; but in 1899 Berg found a rise of level in full progress, the height already attained exceeding not only that of 1874 and 1880, but that of Butakow's records in the 'forties. Islands, for example, which appeared in Butakow's map, and which had become peninsulas in the 'seventies and 'eighties, were submerged. Working from the levels of Tillo at Karatmak, Berg estimated a height of 1·21 metres in 1901 above that in 1874. Glukhowskoy found a fall of 71 centimetres between 1874 and 1880, giving a rise from 1880 to 1901 of about 2 metres, or 9 centimetres a year. The rise has continued, and Berg now gives it as 2·75 metres in 1903, and 3 metres in 1908. The depth of the lake being mostly shallow, this rise corresponds to a very considerable increase in area; the increment in volume of water between 1880 and 1908 is estimated at 20 per cent.

Other lakes to the north, north-east, and east of Aral show a similar rise during the last fifteen or twenty years. Lake Balkash has been rising since 1890; Lake Aschikul, in the Tschu depression, which was dry in 1888, was full in 1900, and there is a marked rise in many lakes in the Kirghiz Steppe, along the line of the West Siberian railway, and elsewhere.

The observations of rainfall taken at Barnaul on the upper Ob since 1838 are of great significance in this connection. The annual amount diminished from 1838 till 1868, then increased rapidly till 1895, and it has remained high, with small variations, since that year, the highest five year average (to end of 1906) being 1902–6.

The evidence goes then to show that the supposed continuous drying up of Central Asia has no existence in fact, but that variations occur which may or may not be periodic. If they are recurrent, the period must extend over at least sixty years, and its precise length cannot be determined before the end of the twentieth century, at the earliest.

Prof. Woeikow adds an interesting section on the history of the Sea of Aral, which has, naturally, important bearings on the question of secular variations of climate. A rise of the river Amu of only 4 metres above the level of 1901 would cause an overflow of part of its waters by the Usboï to the Caspian, one effect of which would be that the sea of Aral would become a fresh-water lake. Historical evidence (see Barthold, "Scientific Results of the Aral Expedition," 1902; and "Historical Geography of Iran," 1903: Berthold, by the way, is of opinion that the climate of Iran and Turan, so far as can be gathered from historical evidence, has remained practically unchanged for 2400 years) goes to show that from the thirteenth to the end of the sixteenth centuries this overflow actually occurred; and it would seem that this was a period of comparatively high rainfall in eastern Europe and western Asia.

A final section of Prof. Woeikow's paper deals with the thermal relations of water and air over the Sea of Aral. Space forbids a summary of the extremely interesting results obtained from Berg's observations, which appeal, perhaps, more to the specialist.

The definite conclusions set forth by so high an authority as Prof. Woeikow are of profound significance. The variations in the breadth of the grass belts between forest and hot desert, whether "savana" or "steppe," afford some of the most complex problems awaiting the geographer; the variation is probably greater the greater the total width of the belt, and the area in which the rainfall oscillates above or below a *minimum* point determining the possibility of human settlement of one kind or another is probably also greater. If it can be established that there is in effect no real evidence to show that in Central Asia a continuous diminution of rainfall is going on, but that a period of 30 or 40 years, or even of 300 years, of relatively small rainfall has passed its minimum, and that a similar period of greater fall has begun, then it follows that the historical problem of the depopulation of many of those regions, a problem of which the question of water supply can form only one element, becomes greatly modified. A thirty years' drought is no doubt sufficient to depopulate any district which has a low rainfall at the best of times, but increased rainfall does not necessarily mean immediate repopulation; and it does not follow that a region which has been deserted by its population at one time, through drought or other cause, has remained uninhabitable ever since. Again, it may be that large areas which for fifty years or more have been regarded as beyond hope will before long yield to modern methods of development and be added for a generation to come to the wheat producing, or at least the "ranching" regions of the world.

It is well that a belief which has often, in the absence of direct evidence, been used to bolster up the conclusion that rainfall was also diminishing a long way from Central Asia (the writer has heard it seriously used to support the contention that diminished yield of wells sunk in the chalk of south-eastern England was due to secular change of climate) should be definitely disposed of irrespective of its irrelevance. Assuming that no case of constant progressive diminution of rainfall in any part of the world has been established, and that none is now likely to be established, the problem seems to be to ascertain the nature and duration of these variations extending over long intervals of time. Are they periodic? if so, what is the length of period? What is the current phase at different parts of the earth's surface, and to what is the difference due? Central Asia has apparently just passed a *minimum* phase—has Central Africa just passed a maximum? Apparently fifty years of observation will be required to settle these questions.

H. N. D.

NOTES.

SIR JOSEPH LARMOR, Prof. Felix Klein, and Prof. H. Poincaré have been elected honorary members of the Calcutta Mathematical Society.

THE new rooms of the Royal Society of Edinburgh will be inaugurated on Monday next, November 8, when Sir William Turner, K.C.B., F.R.S., president of the society, will deliver an address, and a reception will be held.

PROF. K. SCHWARZSCHILD, director of the Göttingen Observatory, has been appointed to the directorship of the Royal Astrophysical Institute of Potsdam, rendered vacant by the death of Prof. Vogel. His position at Göttingen is to be filled by Dr. J. Hartmann, hitherto an assistant at the Potsdam institution.

THE first fellowship established under the will of the late Dr. Sorby, F.R.S., of Sheffield, as reported in our issue of July 8 (vol. lxxxi., p. 42), has been awarded by the joint committee nominated by the Royal Society and the University of Sheffield to Dr. Jocelyn F. Thorpe, F.R.S., who will engage upon a research on the chemistry of the imino-compounds.

A REUTER message from New York states that Mr. J. D. Rockefeller has made a donation of 200,000*l.* in support of a commission of eminent medical men to investigate the hook-worm disease, which is prevalent in the rural districts of the southern States.

A MEETING to inaugurate the new observatory and meteorological station of the Hampstead Scientific Society will be held on Saturday, November 6, at 3.30 p.m., at Heath Mount School, Heath Street, Hampstead. Mr. P. E. Vizard will take the chair, and the speakers will be Dr. F. Womack and Dr. H. R. Mill.

THE eighty-fourth Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Mr. W. Duddell, F.R.S., his subject being "Modern Electricity." The course, which will be experimentally illustrated, will commence on Tuesday, December 28, and will be continued on December 30, 1909, January 1, 4, 6, and 8, 1910.

At the opening meeting of the Institution of Electrical Engineers on November 11, a marble bust, by Hamo Thornycroft, of the late Dr. John Hopkinson, F.R.S., who was president in 1890 and in 1896, will be presented to the institution by Prof. Bertram Hopkinson on behalf of his mother, Mrs. John Hopkinson.

A departmental committee has been appointed by the Home Secretary to inquire into the working of the existing special rules for the use of electricity in mines, and to consider whether any, and, if so, what, amendments are required. The members of the committee are:—Mr. R. A. S. Redmayne (chairman), Mr. C. H. Merz, and Mr. R. Nelson. Correspondence may be addressed to Mr. Nelson at the Home Office.

Preliminary particulars have been sent to us of the United Provinces Agricultural and Industrial Exhibition which is to be held in Allahabad in December, 1910. An agricultural court will form one of the main features of the exhibition, and will be arranged on a scale more extensive than anything previously attempted in India. The Agricultural Department of the United Provinces has assumed responsibility for the agricultural court, and inquiries regarding it should be directed to the Deputy Director of Agriculture, Cawnpore. It is hoped that this court will contain an economic collection of agricultural exhibits of interest, not only to the producer, but also to the consumer and to the manufacturer of finished articles from raw products.

Science in the daily Press usually consists of snippets of sensational information which if true is not new, and if new is not true. Any attempt to represent the true position of scientific work and thought, the progress of research, and the best aims of higher education for the enlightenment of the general public is worthy of encouragement. We are glad to see, therefore, that the *Standard* has decided to pursue the policy of presenting its readers with systematic surveys of scientific research and progress by means of special articles, reports of the proceedings of learned societies, and in other ways. An article upon the place of research in education was contributed by Principal Miers, F.R.S., to Monday's issue (November 1), and Sir Joseph Thomson will discuss the research degree and its working at Cambridge in an article which will appear on the first Monday in December. Particular attention is to be given to research facilities and results, and the intention of the scheme is to make the public realise what the scientific spirit signifies and what is being done by it for the advancement of natural knowledge. Such efforts to direct public attention to the aims, methods, and conclusions of science should lead to increased recognition of the national value of research and higher education. We shall watch the experiment with interest, and in the hope that it will meet with unqualified success.

October was a wet month in nearly all parts of the British Isles, but the excess of rain was due to the remarkable falls which occurred during the closing week, when the south and east of England, especially, came under the influence of a cyclonic disturbance which, for a time, remained fairly stationary over the entrance of the English Channel. The weather report for the week ending October 30, just published by the Meteorological Office, shows that at Broadstairs the total for the period was 6·03 inches, and in three days the rain yielded 5·79 inches; at Margate the total for the week was 5·68 inches, and at Brighton 5·15 inches. On one day in the middle of the week the rainfall at Brighton measured 3·32 inches, at Broadstairs 2·93 inches, at Margate 2·73 inches, and at Shoeburyness 2·50 inches. Some remarkable falls have undoubtedly occurred, but it is rather too early for an exact statement of facts. The aggregate rainfall for the month is reported as 9·82 inches at Shanklin, 9·40 inches at Southampton, and more than 8 inches at Brighton and Bournemouth. At Valencia the total rainfall for October is 8·06 inches, and rain fell every day with three exceptions; at Jersey the total was 7·14 inches. At Greenwich the aggregate measurement for the month is 4·07 inches, whilst the average for October during the last half-century is 2·78 inches, and rain fell on twenty-two days. In 1880 the October rainfall at Greenwich was double the measurement for last month. At several places in Scotland and in the north of England the rainfall for October was slightly less than the average. The month was unusually mild, and the duration of bright sunshine varied considerably in different parts of the country.

In his presidential address to the Institution of Civil Engineers on Tuesday, November 2, Mr. J. C. Inglis did not deal with any particular engineering subject, but rather commented upon the recent activities of the institution, the professional status of the engineer, and the position he occupies in relation to certain economic questions of the day. Referring to the new by-laws and regulations drawn up with the object of securing a higher and more efficient standard of training than has hitherto been required, Mr. Inglis pointed out that there still appears to linger a certain popular confusion of ideas regarding knowledge which can be tested by question and answer in ordinary examination papers, and ability to apply such knowledge intelligently to the practical problems of every-day professional life. The Institution of Civil Engineers, differing perhaps in degree, though not, it is thought, in principle, from the views sometimes entertained by other bodies on this subject, has persevered throughout in the belief that for success in the application of the great powers of nature to the use and convenience of man, there can be, as a rule, no efficient substitute for regular training under those who are practising that art; albeit, the foundation of intelligent work in this direction lies in the possession of sound education and appropriate scientific knowledge. The successful engineer of the future must possess in an increasing degree a thorough knowledge of the principles of design, of the materials to be used, and their behaviour when in use (keeping in view the facility and cost of repairs), and of the actual working conditions affecting the life of the structure or plant or machine designed. The engineer should not only know how to design his works, but be familiar with the conditions under which they are to be used. The practical engineer of the early part of the nineteenth century built up his theory from his personal experience, and applied his self-taught theories according to his judgment. The practical engineer of the twentieth century is he who, knowing the theoretical principles of his profession, employs as data the facts gathered from his experience, and whose generalisations from such experience merely consolidate his knowledge of principles.

Naturen for October contains an appreciative memoir by Mr. P. R. Sollied, accompanied by a portrait, of Emil Christian Hansen (1842–1909), with an account of his bacteriological researches.

We have received a specimen copy of the first part of "Coleopterum Catalogus," edited by Mr. S. Schenkling, and published by W. Junk, of Berlin, this part being the work of Mr. R. Gestro, and dealing with the family Rhysodidæ. Full synonymy of the families, genera, and species is given, but there are no diagnoses. An index of the species of this family is given at the end of the part.

To the October number of the *Zoologist* Mr. A. H. Patterson communicates the first part of an interesting account of the fisheries and fish of east Suffolk, with special reference to the takes of herring and mackerel at Lowestoft. In regard to the apparently capricious movements of the shoals of mackerel, the author expresses the opinion that these are entirely due to tidal and other influences affecting the natural economy of the species.

In their report for the year ending June 30, the members of the committee of the Manchester Museum put on record their regret at the resignation of Dr. W. E. Hoyle, who held the office of keeper (a title latterly changed to director) of the establishment for the long period of twenty years. Dr. Hoyle resigned on March 25, when he was appointed director of the National Museum at Cardiff. Among important additions to the museum during the year under review, reference may be made to a collection of fossil fishes made by the late Mr. John Ward.

According to the *Museum News*, the authorities of the Children's Museum at Bedford Park, Brooklyn, have been devoting their attention during the past summer to exhibits illustrative of the Hudson-Fulton celebration. A large series of the animals inhabiting the country at the time of Hudson's visit has been placed on exhibition, with special notes to those which are now on the point of disappearing or which have been already exterminated. Such species of trees growing in the museum gardens as were native to the country in Hudson's time have also been marked with special labels.

It is satisfactory to learn from the September number of the *Victorian Naturalist* that the colony of sea-lions on "Seal Rocks," in Bass Strait, continues to flourish under Government protection. In November, 1908, a party of naturalists left Melbourne for a cruise in Bass Strait, and one of their number gives the following account of their visit to the sea-lions:—"As we approached this haunt of the seals, hundreds of the animals could be seen in the water, and from the rocks came, borne on the wind, the sound of their voices. The rookery presented a 'moving spectacle,' as we surveyed it through binoculars from the steamer's deck. Huge brown forms were clambering among the pools and darting in and out of the surf, while sleek cubs lay basking in the sunlight beside their anxious mothers." In the same issue attention is directed to the serious destruction now being inflicted on the native bird-fauna of the country by the progeny of introduced European foxes.

In vol. cxviii., part i., of the *Sitzungsberichte der k. Academie der Wissenschaften*, Prof. O. Abel gives a restoration of the skeleton of *Eurhinodelphis cocheteuxi*, of the Belgian Upper Miocene, in which the prolongation of the toothless rostrum far in advance of the lower jaw is well shown. The length of the figured skeleton, which is probably that of a male, is nearly 16 feet, but the majority of specimens are smaller. From the strong development of the caudal vertebræ, indicative of powerful tail-muscles, the author infers that these cetaceans were swift swimmers, while the free cervical vertebræ permitted, as in the fresh-water Iniidæ and Platanistidæ, of considerable movements of the head. These circumstances, taken in connection with the long edentulous rostrum, projecting far in advance of the lower jaw, and the weak state of the dentition generally, suggest that these long-snouted dolphins swam on the surface of the sea, where they captured their food—probably fishes—in much the same manner as does the skimmer (Rhynchops) among birds. Dr. Abel also describes the skull of *Saurodelphis argentinus* from the Argentine Pliocene, and shows that the genus was nearly allied to the existing Amazonian Inia.

The brain of the late Prof. D. J. Mendeléeff, the chemist, has been investigated and described by Profs. W. von Bechterew and R. Weinberg. The results of their investigation, with eight finely finished plates, form the first of a series of monographs dealing with the anatomy and development of the body, which is to be edited by Prof. Wilhelm Roux, of Halle, and published by Mr. W. Engelmann, of Leipzig. The size of the great chemist's brain was above the average, but not remarkably so; its weight was 1571 grams. The convolutions are simple in their arrangement; indeed, no one, from a mere examination of the organ, could have formed any opinion—at least in our present state of knowledge—as to the very special qualities manifested by it in life. Only two features were in any degree peculiar—a highly convoluted part of the left parietal lobe and a comparatively small and simple temporal lobe. Profs. Bechterew and Weinberg have made a very welcome addition to the limited number of descriptions of the genius-brain, and if at present the results of their labour appear to be negative, the day may soon come that will provide a key to the facts which they have been content merely to tabulate and to describe accurately.

Prof. E. Gaupp, of Freiburg, has devoted the fourth part of the "Sammlung anatomischer und physiologischer Vorträge und Aufsätze" to the consideration of the asymmetry of the human body (Jena: Gustav Fischer). From a consideration of the literature dealing with this matter, he has come to the conclusion that asymmetry in the right and left halves of the body is normal, and is to be regarded, not as a defect, which was the opinion formulated by Bichat a century ago, but as an advance and sign of specialisation. The asymmetry of the skull, face, jaws, spine, chest, pelvis, and limbs is not present at birth; it appears as the individual becomes adapted to his surroundings. The asymmetry is not a question altogether of right- or left-handedness or right- or left-brainedness; in Prof. Gaupp's opinion the tendency to a right- and left-sided specialisation is inborn in the individual. The asymmetry is simply exaggerated by the reaction of use and disuse. Classical sculptors represented in their work a degree of asymmetry of the face equal to that seen in modern races. The greater the degree of asymmetry the higher the point of evolution. Prof. Elliot Smith found that the hemispheres of the negro brain, and especially those of the anthropoids, showed a smaller degree of asymmetry than those of European races.

An article by Mr. B. L. Issatchenko, continuing two earlier communications on the conditions for chlorophyll formation, is published in the *Bulletin du Jardin Impérial Botanique*, St. Petersburg (vol. ix., part v.). The author states that a low temperature (−8° C.) does not prevent the formation of chlorophyll, and that it is formed in plants as quickly at a low temperature as a high one, the formation of the pigment depending exclusively on the strength and duration of the light. According to other results obtained, the formation of chlorophyll continues in the presence of the vapour of formaldehyde or chloroform.

Dr. F. Krasser has prepared for publication a series of diagnoses, left by the palæontologist Stur, of some fossil plants found in Triassic beds at Lunz, in Lower Austria, that are assigned to the filicinean family Marattiaceæ. Seven genera and seventeen species are confirmed by Dr. Krasser, of which one genus, Speirocarpus, and ten species are new to science. Five of the genera go back to the Palæozoic, but Speirocarpus and Bernoullia have only been found in Mesozoic strata. The article appears in the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxviii., part i.).

Further information regarding the curious herbaceous Ecanda rubber plant, *Raphionacme utilis*, is published in the *Kew Bulletin* (No. 8). The plant grows abundantly on a plateau in the district of Bihé, Portuguese West Africa; it produces a short leafy shoot and a good-sized tuber, from which the rubber is obtained. The tubers vary in weight up to 5 lb., and occasionally exceed this measure. It seems probable that there may be more than one species. The plants can be propagated from seed, but take several years to reach a marketable size. In the same number of the Bulletin there appears a short note, by Mr. J. M. Hillier, with reference to a new rubber plant, *Asclepias stellifera*. The identification refers to samples of root rubber forwarded by Mr. J. Burtt Davy from the Transvaal, one of which was reported to be of good quality.

A fact of peculiar interest in connection with plant distribution is presented by Dr. Engler in the discovery, announced in his *Botanische Jahrbücher* (vol. xliii., part iv.), of an African plant referred to the family Triuridaceæ. The plants of this family are saprophytes of such a reduced nature that there is some doubt whether they are correctly classed with monocotyledons. Several species, under two genera, have been discovered in tropical America and tropical Asia; also a new species from the Seychelles islands was described by Mr. Botting Hemsley in 1907. The latest species was collected in West Africa, in the Cameroons, so that the genus Sciaphila is now recorded from three continents. It is quite unlikely that the seeds of a plant which is a saprophytic inhabitant of virgin forest should be transported by water, and the problem of its existence in these distant isolated localities is exceedingly puzzling. An anatomical examination of the stem showed a reduced structure not inconsistent with a monocotyledonous position.

Under the subtitle "Les Districts littoraux et alluviaux," the Jardin botanique de l'État has issued, with the authority of the Belgian Ministère de l'Intérieur et de l'Agriculture, the first portion of a work on "Les Aspects de la Végétation en Belgique," by Profs. C. Bommer and J. Massart. The studies of these two authors in this field, the results of which have appeared in the pages of the *Bulletin de la Société royale de Botanique de Belgique*, are already well and favourably known. In a brief *résumé* Prof. Th. Durand, director of the Brussels Botanic Garden, explains the object the authors have in view, and informs us that the work, in its complete form, will include some 400 plates distributed in five parts, as follows:—i., Districts littoraux et alluviaux, by Prof. Massart; ii., Districts flandrien et campinien, by the same author; iii., Districts argilo-sablonneux et crétacé, by Prof. Bommer; iv., Districts calcaire et jurassique, by Prof. Massart; and v., District ardennais, by Prof. Bommer. The work will include in its scope the illustration both of the cultivated and of the uncultivated portions of Belgian territory, and will endeavour to give a complete picture of the vegetation of the whole country. The method adopted by the authors in preparing their illustrations has involved their securing photographs on plates measuring 30 cm. by 40 cm. With the object of rendering available for independent use the more important of these plates, it has been resolved to issue a reduced edition containing about one-fourth of the plates in the complete work. The copy of this reduced edition of the first volume, now under notice, contains twenty-four plates as against eighty-six plates in the complete edition of the same volume. These plates are excellent reproductions from photographs of great beauty. They largely explain themselves, and are highly instructive. The accompanying letterpress is reduced to a brief amplification, in three pages, of the systematic summary of the plates, whereof 1 and 2 illustrate the District des Estacades et Briselames; 3–9, the District des Dunes littorales; 10–13, the District des Alluvions marines; 14 and 15, the District des Alluvions fluviales; 16–22, the District des Polders argileux; while 23 and 24 illustrate the District des Polders sablonneux et des Dunes internes.

The thirty-first and thirty-second reports of the Connecticut Agricultural Station for the years 1907–8 form a volume running into nearly a thousand pages. A considerable amount of space is devoted to the reports from the analytical laboratories, where large numbers of foodstuffs intended for human consumption are investigated in addition to the ordinary agricultural materials. In accordance with the American system, results of the analysis are published, together with the trade name of the article, the manufacturer, the dealer, the price, and the guaranteed composition, so that one can see at a glance which articles are above and which below their guarantees. Dr. Osborn, head of the laboratory for the study of proteids, reports that he has isolated a new substance from one of the wheat proteins, a di-peptide of proline and phenyl-alanine. This substance is important, not only in connection with the structure of wheat protein, but in connection with the chemistry of proteins in general. Quantitative determinations have also been made of the amounts of decomposition products of various vegetable proteins. The entomological department has spent much effort in subduing the gypsy moth at the only place in the State where it was found. The infected area was isolated by destroying the shrubs and bushes on all sides of it as far as possible; within the area all larvæ, pupæ, and egg-masses discovered were destroyed; 14,000 trees were banded and inspected daily. A new orchard pest, the peach saw-fly, which threatened great injury, was completely controlled by spraying with lead arsenate. In the agricultural department a number of experiments are recorded on the hybridisation of potatoes. The botanist records studies of the "calico" disease of potatoes, and chlorosis in other plants, the downy mildew of Connecticut, the root rot of tobacco caused by the fungus *Thielavia basicola*, and of certain heterœcious rusts of Connecticut having a peridermium for their œcial stage. The forester has carried out experiments on the economical planting of white pine, on different methods of seeding and planting forest trees, on the fertilisation of young trees by growing cow peas, on the progress of the white pine disease, and on methods of treating the pine weevil. The increased interest in forest planting in Connecticut is shown by the fact that about 100,000 forest trees were planted in 1906, 350,000 in 1907, and 600,000 in 1908. A forest survey is in hand, and a fire service has been organised.

Prof. L. Duparc, assisted by Dr. Francis Pearce and Madame Tikanowitch, his colleagues in the University of Geneva, has issued the third and concluding part of his "Recherches géologiques et pétrographiques sur l'Oural du Nord; le Bassin de la haute Wichéra" (*Mémoires de la Société phys. et d'Hist. nat. de Genève*, vol. xxxvi., fascicule i., July, 1909, price 20 francs). The results of three expeditions, from 1904 onwards, are here reviewed, and the igneous and metamorphic rocks are described in considerable detail. The region lies on the west side of the Urals and north of Solikamsk, where numerous streams unite, flowing from a broad basin, to form the Vishera River, which in turn flows into the Kama, and thus into the Volga system. The plateaus, covered with stones and showing few good rock-exposures, represent a mass uplifted during the Hercynian earth-movements, and subjected to prolonged denudation. Interesting terrace-structures, preserved only among the hard quartzitic ranges, point to ancient epochs of erosion under conditions different from those of the present day. Successive terraces rising above one another, and apparently independent of tectonic structure, offer a problem which Prof. Duparc is compelled to leave at present unexplained. They certainly suggest, in the numerous sketches given, relics of abnormally large terraces of marine erosion rather than uplifted peneplains. Among the petrographic descriptions we note that a highly pleochroic amphibole, associated with magnetite, occurs in one of the ore-materials; the authors believe this to be a new species, and have elsewhere given it the name of "Tschernichéwite." Its characters are as yet incompletely determined; if we may judge from those here given, its weak birefringence seems to ally it to riebeckite, while its axial plane is in an unusual position for an amphibole, and its pleochroism is near that of glaucophane. The iron mines of the district are carefully described, and the memoir is well illustrated by photographic views and effective drawings of broad landscapes.

IN the *Reliquary* for October Mr. T. Sheppard, curator of the Municipal Museum, Hull, records the discovery at Malton, in Yorkshire, of two interesting bronze statuettes, one, the more primitive of the two, representing Hercules bearing the skin of the Nemean lion, the other Venus. They probably belong to the third century A.D., and may have been lost or buried at the time the Roman legionaries were withdrawn from Britain.

THE Meteorological Chart of the North Atlantic Ocean for November, issued by the Meteorological Committee, contains an account of a West India hurricane experienced by the ship *Barranca* (Captain W. Long) in August last. At noon on August 15 she was in 24° 42′ N., 57° 1′ W., with a falling barometer and strong easterly breeze. At 4 p.m. the barometer failed to respond to the diurnal range, which showed that a storm was not far distant. On the morning of August 16 the ship met the full force of the hurricane, and at 2h. p.m. the sea was "like a boiling cauldron." Next day the east wind veered to south-west, and the ship's position at noon was 22° 43′ N., 61° 44′ W., having apparently drifted some 100 miles to the north, out of her south-west course, in two days. Owing to careful navigation, in accordance with the rules laid down in the "Barometer Manual" issued by the Meteorological Office, the only damage sustained by the ship was a severe straining.

IN the *Rendiconti della R. Accademia dei Lincei* (vol. xviii., 1909) Dr. F. Eredia publishes an interesting preliminary note on the frequency of wind-direction in central Italy. The discussion shows clearly the different effects of the two slopes which divide the country from the Adriatic and Tyrrhenian Seas. Winds from N.–E. prevail along the Adriatic slope in summer and along the Tyrrhenian slope in winter, and winds from S.W.–N.W. predominate in winter along the Adriatic slope and in summer along the Tyrrhenian slope; thus, while one direction has its maximum of frequency on one slope, it has its minimum along the other. The author endeavours to explain these facts and to compare them with the theoretical laws of the circulation of the atmosphere.

A VALUABLE series of articles on life in the various colonies and other countries in which many of our young electrical engineers obtain posts has appeared in the *Electrical Review* during the last two months. Although intended, in the first instance, for electrical engineers, they will prove of great value to all who have thoughts of taking up appointments abroad, as they are in every case by men with practical experience of the countries about which they write. Each article deals with the climate of the country, the cost of living, the salaries, and the ultimate prospects of those taking up posts open to Europeans.

THE vacuum vessel introduced by Dewar has proved of such value as a means of improving the thermal insulation of bodies that it is no surprise to find it introduced into calorimetry. At the suggestion of Prof. Nernst, of the University of Berlin, Dr. H. Schottky has carried out a series of measurements with a modified form of Favre and Silbermann calorimeter, in which the mercury was replaced by pentane and the bulb of the calorimeter surrounded by a vacuum vessel. The instrument looks like a Bunsen ice calorimeter using pentane instead of ice, and having a vacuum vessel around its bulb. It has proved a great improvement on its predecessors, and is considered by Dr. Schottky to be extremely accurate. A full description appeared in the *Physikalische Zeitschrift* for September 15.

WE have received separate copies of a number of papers which have been written by the staff of the Physikalisch-technische Reichsanstalt, and have appeared in the *Annalen der Physik* and other periodicals during the past few months. Two of them deal with optical subjects, and are of special interest. In the first place, it has been found by Drs. E. Gehrcke and G. Leithauser that it is possible to convert a celluloid copy of a diffraction grating, such as have been made by Thorpe, of Manchester, for some time, into a reflecting grating by dusting it with kathode particles in a vacuum. The process gives gratings which are almost as good as the original. Further, Dr. L. Janicke has been investigating the properties of the spectral lines of the metallic elements by the high dispersion obtainable with the Lummer-Gehrcke plate spectroscope, and gives the wave-lengths of the sharp lines of the spectra of fourteen elements, which were used as the anodes of arcs burning *in vacuo*.

AT a recent meeting of the Association of Municipal and County Engineers a paper was read on the "G.B." tramway system and its results in Lincoln by Mr. S. Clegg, the city electrical engineer. The author stated that during the first twelve months a total of seventy-one live studs was recorded, these being mostly owing to defects in details in the original construction. The old type of cable had been completely replaced in 1908, and the average at present is about three live studs per month. Mr. Clegg considers that there is less danger to the public from shock and personal injury with the "G.B." system than with the overhead system. Studs which had become alive at Lincoln had always been located as soon as they occurred without danger to anyone.

Commenting on the aviation meetings at Doncaster and Blackpool, *Engineering* for October 22 directs attention to the advantages of the monoplane from the point of view of transport from place to place. The frame consists simply of the backbone carrying the engine, driving-seat, and controlling gear, together with the wheels on which the machine runs when on the ground. This can be sent complete in one piece, the main wings and the horizontal and vertical rudders being detached for the purpose. The wings are attached very easily by means of sockets on the backbone and by wire ties. In the case of one competitor, whose main wings had not arrived until late in the morning, these were all fixed up in about an hour. Probably with more experience it will be possible to design a monoplane which can be taken to pieces or erected complete in an hour or two. The biplane, having more numerous tie-rods, appears to require much larger packing cases or more time for its erection, according to the extent to which it is taken to pieces. In the air the biplanes certainly appear to be more steady than the monoplanes, the latter occasionally flying in a series of dips, especially when near the ground. When high up, however, the monoplane appeared very steady.

While remarking on the enormous advance which has been made in aviation, *Engineering* points out that the motors have very far from the trustworthiness required for practical work, and each machine had several mechanics in attendance on it. The engines at present in use require a large amount of attention. This is a matter which should be capable of amendment. The other limitations which require attention are the incapacity for flying in bad weather and for alighting on rough ground. To be of any practical use, aëroplanes should be capable of alighting and starting from an ordinary grass or stubble field, and there does not seem the least difficulty in arranging for this; in fact, the combination of runners and wheels on the Farman machine would probably be satisfactory. Flying in a wind may possibly be largely a matter of practice and confidence, and it is quite possible that, with very little alteration in the machines, men will learn to fly in any reasonable weather.

Erratum. In the article upon the magnetic results of the *Carnegie* (October 28, p. 532, col. 2, line 3 from bottom) Dr. Bauer should have written $\frac{1}{2}^{\circ}$ instead of $\frac{1}{2}'$, which was the value given in the typewritten communication received from him and printed in Nature.

OUR ASTRONOMICAL COLUMN.

Changes on Mars.—Another large prominence on the terminator of Mars is announced by M. Jarry-Desloges in No. 4364 of the *Astronomische Nachrichten* (p. 335). This object was seen on the night of October 14–15 in the region of Phaëthontis, which itself was very white; this whiteness of Phaëthontis, and similar regions near the limb, was remarked by the Rev. T. E. R. Phillips in his observations of 1903.

A drawing of the planet, as it was seen by M. Antoniadi with an 83-cm. reflector on September 20, is published as a frontispiece to No. 10, vol. iii., of the *Rivista di Astronomia* (Turin).

Halley's Comet.—In No. 4364 of the *Astronomische Nachrichten* (p. 333, October 20) Prof. Wolf publishes the position of Halley's comet as determined from a plate taken on October 10, and states that, with a power of 140 used on the reflector, he is able to see the comet as a small nebulous patch; but it is on the limit of visibility with this instrument, its magnitude being given as 14·5.

In the same journal (p. 335) Mr. Knox Shaw gives positions determined from photographs taken at the Helwan Observatory on September 13, 15, and 16 respectively.

An interesting popular article, dealing with the history and nature of the comet, appears in part cxliii. of *Chambers's Journal* (p. 710, November 1) from the pen of Dr. Alex. W. Roberts.

Sun-spot Spectra.—A summary of the results so far obtained from the study of the photographs of sun-spot spectra, taken at the Mount Wilson Observatory, is published by Prof. Adams in No. 2, vol. xxx., of the *Astrophysical Journal* (pp. 86–126, September).

The paper is too comprehensive for adequate summary in these columns, where many of the details have already appeared, but the various tables given will prove interesting and instructive to all workers in this branch of solar physics.

Prof. Adams believes that the intensification of various solar lines in the spot spectrum is due to the lowering of temperature, and not, in general, to a variation of pressure. Investigations at Mount Wilson, where a shift of 0·003 or 0·004 Å. could be detected, indicate that the excess of pressure in spots, over that on the surface of the sun, can hardly be so great as one atmosphere. A study of the enhanced lines, based mainly on the tables published by Lockyer, shows that of 144 such lines 130 are distinctly weakened, while fourteen show no change, in passing from the Fraunhoferic, to the spot, spectrum.

The lines of each element are studied *seriatim*, and of the lines of iron given by Rowland, 784, or 71 per cent., are affected in the spot spectrum; of the 558 lines due to iron alone, 300 are strengthened and 258 weakened in passing from the solar to the spot spectrum. The behaviour of the iron lines is best explained by the decrease of temperature in the spot.

The greater part of the unknown fluting, and band, lines in the spot spectrum may be accounted for by the presence of the titanium oxide, "magnesium hydride," and "calcium hydride" spectra, whilst the lines that are widened without marked increase of intensity are sufficiently explained by the existence of a magnetic field in sun-spots.

Designations of newly discovered Variable Stars.—The committee for the A.G. Catalogue of Variable Stars publishes the permanent names of sixty-two recently discovered variables in No. 4364 of the *Astronomische Nachrichten*. The provisional name, permanent designation, position, and magnitude range are tabulated for each object, and a series of notes gives particulars of discovery and subsequent observations.

The Motions of Some Stars in Messier 92 (Hercules).—Prof. Barnard discusses the proper motions of certain stars in the cluster M. 92 in a paper appearing in No. 4363 of the *Astronomische Nachrichten*.

Micrometer observations of this cluster were made by Schultz, at Upsala, about 1873, and results were published for thirty-seven stars. These results, when compared with those obtained from a photograph taken in 1898, led Dr. Bohlin to the conclusion that some of the stars exhibited large proper motions during the twenty-five years' interval, but Prof. Barnard suggested that Schultz's observations of faint objects with a 9-inch telescope were probably not sufficiently exact to permit of this deduction; measurements of two photographs, taken with an interval of eight years between them, confirm the suggestion.

There are two stars, however, which show decided motions during the eight-year interval, one being No. 11 and the other a fainter star temporarily designated a. The former has an annual motion of 0·085″ in position angle 220° (8·5″ per century), and the second an annual motion of 0·065″ in position angle 181·4° (6·5″ per century). Prof. Barnard concludes that another fifty years should show motion in many of the stars of this cluster, whilst within a few hundred years it will be possible to investigate the laws which control the motions of this and similar great and crowded masses of stars. A carefully oriented reproduction of a photograph of M. 92, taken with the 40-inch telescope, accompanies the paper, and will facilitate further work on this interesting cluster.

SOLAR VORTICES AND MAGNETIC FIELDS.[1]

I HEARTILY appreciate the privilege of describing in this lecture-room some of the recent work of the Mount Wilson Solar Observatory. Like so much of the scientific research of the present day, it goes back for its origin to the fundamental investigations of English men of science. The spectroheliograph, which tells us of the existence of solar vortices, is a natural outcome of the application of the spectroscope in astronomy, where Englishmen were foremost among the pioneers. The detection of a magnetic field within these vortices followed directly from Zeeman's beautiful discovery of the influence of magnetism on radiation—a logical extension of the earlier work of Faraday—and from the classic investigations of Crookes and Thomson on the nature of electricity. In reviewing these great advances, investigators in other lands must again and again wonder at the exceptional ability of the English mind to make fundamental discoveries. When these discoveries have been made it is a comparatively simple matter to utilise them in many departments of science. Americans cannot fail to rejoice that they may share in the traditions of a race which counts among its members the men who have given the Royal Institution its fame.

It is customary to distinguish sharply between the observational and experimental sciences, including astronomy in the former. In physics or chemistry the investigator has the immense advantage of being able to control the conditions under which his observations are made. The astronomer, on the other hand, must be content to observe the phenomena presented to him by the heavenly bodies, and interpret them as best he may. I wish to emphasise the fact, however, that the distinction between these two methods of research is not so fundamental as it may at first sight appear. In 1860 a laboratory, in which experiments were conducted for the interpretation of astronomical observations, was established by Sir William Huggins on Upper Tulse Hill. The advantage of imitating celestial phenomena under laboratory conditions was thus appreciated half a century ago. I shall indicate later how important a part such a laboratory plays in the work of the Mount Wilson Solar Observatory. I shall also show that in other ways the astronomer may advantageously follow the physicist, particularly in the choice of observational methods and in the design of instruments of research.

Sun-spots were discovered as soon as Galileo and his contemporaries directed their little telescopes to the sun. In fact, ancient Chinese records indicate that spots of exceptional size had been detected by the naked eye many centuries before. Long after their discovery, the most diverse views were held as to the nature of sun-spots. Sir William Herschel mentioned the uncertainty which had existed prior to his time, remarking that the spots had been variously described as solid bodies revolving about the sun, very near its surface; the smoke of volcanoes; smoke floating on a liquid surface; clouds in the solar atmosphere; the summits of solar mountains, uncovered from time to time by the ebb and flow of a fiery liquid, &c. In Herschel's own view the spots are to be considered as the opaque body of the sun seen through openings in the luminous atmosphere which envelops it. Indeed, he considered that the sun should be regarded as the primary planet of our system, and even suggested the probability that it is inhabited. "Whatever fanciful poets might say, in making the Sun the abode of blessed spirits, or angry moralists devise, in pointing it out as a fit place for the punishment of the wicked, it does not appear that they had any other foundation for their assertions than mere opinion and vague surmise; but now I think myself authorised, *upon astronomical principles*, to propose the Sun as an inhabitable world, and am persuaded that the foregoing observations, with the conclusions I have drawn from them, are fully sufficient to answer every objection that may be made against it."[2]

Sir John Herschel did not abandon the idea of an opaque solar globe, but suggested that hurricanes or tornadoes might account for the piercing of the two strata of luminous matter which ordinarily conceal this globe. "Such processes cannot be unaccompanied by vorticose motions, which, left to themselves, die away by degrees and dissipate—with this peculiarity, that their lower portions come to rest more speedily than their upper, by reason of the greater resistance below, as well as the remoteness from the point of action, which lies in a higher region, so that their centre (as seen in our water-spouts, which are nothing but small tornadoes) appears to retreat upwards. Now, this agrees perfectly with that which is observed during the obliteration of the solar spots, which appear as if filled in by the collapse of their sides, the penumbra closing in upon the spot, and disappearing after it."

We now know that sun-spots are brighter than the brightest arc light, and that their apparent darkness is merely the result of the contrast with the intensely brilliant surface of the photosphere. We also know that the sun is a gaseous globe, attaining a temperature of about 6000° at its surface, and perhaps millions of degrees at its centre. If we examine a large-scale photograph of a sun-spot we see that it consists of a dark central region, called the umbra, and a surrounding area, decidedly less dark, called the penumbra. The structure of a spot, as this admirable photograph by Janssen shows, is granular, like that of the photosphere. In the penumbra these granulations seem to group themselves more or less radially, as though under the influence of some force directed toward or away from the umbra. Unfortunately, direct photographs of the sun have not yet attained such perfection as to show the most minute details of sun-spots. To appreciate these, we must have recourse to the exquisite drawings of Langley, the truthful quality of which is recognised by every astronomer who has observed sun-spots under favourable conditions. We shall see that the characteristic structure represented by these drawings is repeated, on a far greater scale, in the higher regions of the solar atmosphere disclosed on recent spectroheliograph plates.

Since the time of Sir John Herschel, many astronomers have proposed vortex theories of sun-spots. One of the first of these is the theory of Faye, who supposed the whirling motion to be the direct result of the peculiar law of the sun's rotation. This law was discovered by Carrington, who found from observations of spots near the equator that the sun completes a rotation in about twenty-five days, while the motion of spots at a latitude of 40° indicated the time of rotation to be nearly two days longer. Thus, as the rotation period increases toward the poles, the photosphere at the northern and southern boundaries of a sun-spot must move at different velocities (assuming the law of the sun's rotation to be the same as that of the spots). This difference in velocity would tend to set up whirling motions, clockwise in the southern hemisphere and counter-clockwise in the northern hemisphere. Sun-spots, in Faye's opinion, are the visible evidences of such whirls.

This theory has had many supporters, but it is now generally agreed that the difference in the rotational velocity of adjoining regions of the photosphere is not nearly sufficient to account for the observed phenomena. Secchi, one of the most assiduous observers of solar phenomena, was strongly opposed to Faye's theory. He pointed out that about 6 per cent. of the spots he observed gave some evidence of cyclonic action, but in the vast majority of cases such forms as Faye's theory seemed to demand were lacking. We nevertheless owe to Secchi a most striking drawing of a sun-spot vortex.

When the spectroheliograph was first systematically applied to solar research in 1892, many rival theories of sun-spots occupied the field. Since the function of this instrument is to photograph the phenomena of the invisible solar atmosphere, it might be hoped that the results would throw much light on the nature of sun-spots. For many years, however, this hope was not realised. The first monochromatic images of the sun were made with the K line of calcium. If we compare such an image with a direct photograph of the sun, made in the ordinary way, we see that the sun-spots are surrounded and frequently covered by vast clouds of luminous calcium vapour. These attain elevations of several thousand miles above the sun's surface, but they must not be confused with the prominences, which ascend to much higher elevations. When observed at the sun's limb, the bright calcium flocculi, as these luminous clouds are called, are so low, in comparison with the prominences, that they can hardly be detected as elevations. Thus our knowledge of the calcium flocculi must be derived mainly from the study of spectroheliograph plates, which show them in projection on the disc. I must not omit to mention, however, that the calcium vapour rises to the highest parts of the prominences, and that this higher and cooler vapour frequently indicates its presence on spectroheliograph plates in the phenomena of dark flocculi. These are relatively inconspicuous, however, and need not be discussed here.[1]

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[1] Discourse delivered at the Royal Institution on Friday, May 14, by Prof. George E. Hale, For.Mem.R.S.

[2] William Herschel, "On the Nature and Construction of the Sun and Fixed Stars," p. 20.

It soon appeared that the average photograph of bright calcium flocculi could not be counted upon to indicate the existence of definite streams or currents in the solar atmosphere. In 1903 the hydrogen flocculi were photographed for the first time. By comparing these flocculi with the corresponding calcium flocculi we see that, in general, dark regions on the hydrogen image agree approximately in form with bright regions on the calcium image. This might appear to indicate that hydrogen is absent in the regions where calcium is most abundant. An investigation of the question, however, does not lead to this conclusion. Dark hydrogen flocculi seem to mark those regions on the sun's disc where hydrogen is present as an absorbing medium, which reduces the intensity of the light coming through it from below. In certain areas, where the temperature is higher or the condition of radiation otherwise different, the hydrogen flocculi are bright. In many cases eruptions are in progress at these points, but in others the difference in brightness is apparently not the direct result of eruptive action.

The hydrogen flocculi, thus photographed with the lines Hβ, Hγ, or Hδ, differ in many respects from the calcium flocculi. Not only do they usually appear dark, where the calcium flocculi are bright: their forms exhibit striking peculiarities, which are absent or much less conspicuous in the case of calcium. The appearance of the calcium flocculi resembles that of floating cumulus clouds in our own atmosphere; their capricious changes in form reveal the operation of no simple law. But the hydrogen flocculi, on the contrary, exhibit a definiteness of structure in striking contrast to this appearance. Some of the photographs strongly remind us of the distribution of iron filings in a magnetic field, and suggest that some unknown force is in operation.

Such was the condition of the subject when the red Hα line of hydrogen was first applied to the photography of the flocculi, on Mount Wilson, in March, 1908. The calcium and hydrogen flocculi had been studied for several years, and much had been learned as to their nature and their motions. It had been found, for example, that the calcium flocculi observe the same law of rotation that governs the motions of sun-spots, while the hydrogen flocculi apparently follow a different law, in which the decrease in the angular rotational velocity from the equator toward the poles is much less marked. The latter result is in harmony with the investigations of Adams, whose accurate measures of the approach and recession of the hydrogen at the eastern and western limbs of the sun offer but little evidence of equatorial acceleration on the part of this gas. For this and other reasons it had been concluded that the hydrogen shown in such photographs reaches a higher level than the vapours of the bright (H_2) calcium flocculi. The region of the atmosphere previously explored with the spectroheliograph was nevertheless confined (except in the case of eruptions and dark calcium flocculi) to a comparatively low level, lying within a few thousand miles of the photosphere. What might be expected if a still higher region could be satisfactorily photographed in projection on the disc?

The red line of hydrogen offered the means of disclosing the phenomena of this higher atmosphere. As it may not immediately appear why different lines, caused by the radiation of the same gas, should not give precisely similar photographs, a brief reference to the aspect of a prominence in the red and blue hydrogen lines may be advantageous. Here are two photographs of the same prominence, seen in elevation at the sun's limb, one made with Hα, the other with Hδ. As the red line is very bright, even in the highest regions, the photograph taken with its aid shows the entire prominence. Hδ, on the other hand, is relatively weak at the higher levels, and consequently only the lower and brighter parts of the prominence are well recorded when this line is used. If, now, we suppose ourselves immediately above such a prominence, at a point where we observe it in projection against the disc, it is evident that the character of the hydrogen lines must depend upon their brightness at different levels. As we know that, speaking generally, absorption is proportional to radiation, the amount of light absorbed in the upper part of the prominence will be much greater for Hα than for Hδ. Hence the average level represented by the absorption of Hα will be higher than the average level represented by Hδ, since the higher gases play a more important part in the production of the former line. We may therefore expect that photographs of the sun's disc, taken with the light of Hα, will show the dark areas corresponding to absorption in the prominences much more clearly than photographs taken with Hδ. Moreover, since Hα is stronger than Hδ in the upper chromosphere, in regions where no prominences are present, the *average* level represented by this line will, in general, be higher than that represented by Hδ. A comparison of two photographs of the sun's disc, made with the lines in question, will suffice to make this clear. This enormous group of prominences, stretching for several hundred thousand miles across the sun, is much more clearly indicated by Hα than by Hδ. In general, the hydrogen flocculi are stronger and more distinct when photographed with Hα, and there are some regions which appear bright with Hα and dark with Hδ. This latter peculiarity probably has an important bearing upon the similar behaviour of hydrogen in certain stars and nebulæ, but a discussion of this question cannot be undertaken here.

FIG. 1.—Direct Photograph of Sun-spot Group. 1908, April 30, 6h. 25m a.m. Pacific Standard Time.

The first of the Hα photographs gave strong hopes of a substantial advance in our knowledge of the solar atmosphere. The sharpness and comparatively strong contrast of these flocculi, and the evidences of definite structure and clearly defined stream lines which they revealed, were highly encouraging. The work was begun during the disturbed weather of the rainy season, when the definition of the solar image is never of the best. On April 30, 1908, the first photographs were secured under the fine atmospheric conditions which prevail in the dry season. A direct photograph (Fig. 1) shows a small and insignificant group of sun-spots, which would not seem, without other indications, to merit special attention. The next photograph (Fig. 2) shows that an enormous calcium flocculus occupied this region of the sun, but its form was in no wise remarkable, and afforded no evidence of the phenomena brought to light by the Hα photograph. The structure recorded with the aid of the latter line (Fig. 3) recalls Langley's sun-spot drawings, and suggests the operation of some great force related to the sun-spot group. The same cyclonic structure had been less satisfactorily recorded on the previous day, but a comparison of the two photographs failed to indicate such changes as motion along the apparent stream lines might be supposed to produce.

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[1] Eruptive prominences are also recorded on the disc as bright floccul'.

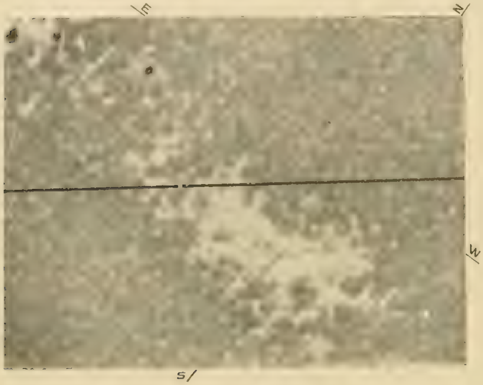

FIG. 2.—Same Region of the Sun, showing the Calcium (H_2) Flocculi. 1908, April 30, 4h. 43m. p.m. P.S.T.

The close of the rainy season now permitted an active study of the Hα flocculi to be undertaken. Many photographs were made daily, and the almost constant association of apparent cyclonic storms or vortices with sun-spots became evident. During several months of the year in California an unbroken succession of clear days can be counted upon, so that the changes of a given vortex can be followed without interruption. The cyclonic storms were found to be of two principal types, the first associated with groups of spots and represented in such photographs as those of April 30 and September 2, the second associated with single spots, and resembling a simple vortex, as illustrated in the photographs of September 9 and October 7, 1908 (Fig. 4). The appearance of these simple vortices is such as to indicate rotation in a clockwise direction in the southern hemisphere, and in a counter-clockwise direction in the northern hemisphere (assuming the direction of motion to be inward toward the spot). However, this cannot be taken as a general law, corresponding to the law of terrestrial cyclones. Indeed, many instances have been found of closely adjoining spots, in the same hemisphere and frequently in the same spot-group, having magnetic fields of opposite polarity, produced by vortices rotating in opposite directions.

In some cases, at least, these vortices seem to exercise a powerful attraction on the surrounding gases, as a series of photographs taken on June 3, 1908, illustrates. A long dark hydrogen prominence, first photographed in elevation at the sun's limb on May 28, had advanced half-way across the solar disc. It lay at the outer boundary of a well-defined vortex, centred on a sun-spot. This spot had been gradually separating into two parts, and on June 3 the separation was complete. The first photograph of a series of nine was made on this day at 4h. 58m. Several successive photographs indicated no appreciable change, but one taken at 5h. 07m. showed that the prominence was developing an extension toward the spot. At 5h. 14m. this had assumed the appearance illustrated in the next photograph, and eight minutes later, when the last photograph of this series was taken, the extension had almost reached the spot. It will be seen that it divided into two parts, which indicates that each umbra was a centre of attraction. The average velocity of the motion toward the spot was more than 100 km. per second. Later photographs, made on the following days, show a ring of bright hydrogen surrounding the spots, suggesting that the comparatively cool hydrogen carried down into the spots was re-heated and returned to the surface, after escaping from the lower end of the vortex. We thus seem to be observing some of the phenomena of an actual vortex in the sun; but it must not be supposed that cases of this kind are common. In many instances the hydrogen flocculi do not appear to move rapidly toward or away from spots, but undergo changes of intensity, as though the physical condition of the gas were constantly changing; but before proceeding further with a discussion of these sun-spot vortices, let us turn to another phase of the subject, which will afford much new information indispensable for this purpose.

We are all familiar with the effect produced by passing an electric current through a wire helix. The lines of force of the resulting magnetic field are parallel to the axis of the helix, and its intensity is determined by the diameter of the helix, the number of turns of wire, and the strength of the current. We also know, from Rowland's experiment, that the rapid revolution of an electrically charged body will produce a magnetic field. Thus, if a sufficient number of electrically charged particles were set into rapid revolution by the solar vortices, a magnetic field should result. What warrant have we for assuming the existence of charged particles in the sun, and how could such a field be detected?

Let me pass rapidly in review a series of phenomena with which you are all familiar. Sir William Crookes showed in this lecture-room, so long ago as 1879, that the negative pole of a vacuum tube sends out a stream of particles, capable of setting a light windmill in rotation, and deviated from their straight path when under the influence of a magnetic field. He has kindly consented to show the same tube again to-night; you now see the effect upon the screen. The recent work of Sir Joseph Thomson and others has proved that these are negatively charged particles, called "corpuscles" or "electrons," and that their mass is about 1/1700 of the mass of an atom of hydrogen. Moreover, Thomson has shown that at low pressures these corpuscles are given off from a hot wire or from the carbon filament of an incandescent lamp. He has also demonstrated that this property of emitting

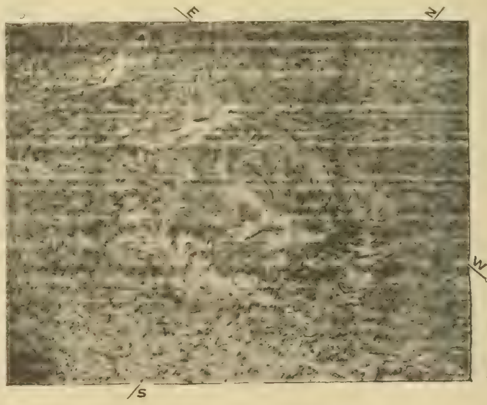

FIG. 3.—Same Region of the Sun, showing the Hydrogen (Hα) Flocculi. 1908, April 30, 5h. 06m. p.m. P.S.T.

corpuscles at high temperature is common to carbon and to metals, whether in the solid or in the vaporous condition. Thus we have warrant for the belief that the sun, composed of just such elements as constitute the earth, must emit great numbers of these corpuscles. As Thomson has estimated that the rate of emission of a carbon filament at its highest point of incandescence may amount to a current equal to several amperes per square centimetre of surface, we can hardly be mistaken in assuming the existence of still more powerful currents in the sun. The emission of negatively charged particles implies the emission of positively charged particles, but in laboratory experiments, because of unequal rates of diffusion or other causes, charges of one sign are always found to be in excess. We thus have reason to believe that powerful magnetic fields may result from the revolution of these particles in the solar vortices.

In seeking a means of detecting such fields, let us first recall Faraday's discovery of the effect of magnetism on light, made at the Royal Institution in 1846. This discovery relates to the rotation of the plane of polarisation of light when passed through a plate of dense glass in a strong magnetic field. Although Faraday, in what was said to be his last experiment, endeavoured to detect the effect of magnetism on the lines of the spectrum, he failed because the apparatus then available was not sufficiently powerful. In 1896 Prof. Zeeman examined with a large spectroscope the two yellow lines emitted by sodium vapour in a flame between the poles of a powerful magnet. Observing in the direction of the lines of force, he saw that the sodium lines widened when the magnet was excited. Subsequently, with more powerful apparatus, he found that a single line, when observed under the above conditions, is split into two components by a magnetic field. The distance between the two components is a measure of the strength of the field; but the most characteristic quality of these double lines, which distinguishes them from double lines produced by any other known means, is the fact that the light of the two components is circularly polarised in opposite directions. If, then, we encounter a double line in the spectrum of any substance, and suspect it to be due to a magnetic field, we must apply the test for circular polarisation.

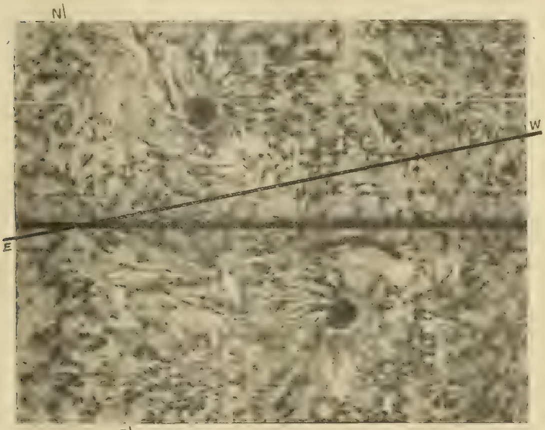

FIG. 4.—Sun-spots and Hydrogen Flocculi, showing Right- and Left-handed Vortices. 1908, October 7, 7h. 02m. a.m. P.S.T.

The simplest means of testing for circularly polarised light is to transform it into plane polarised light by passing it through a quarter-wave plate or a Fresnel rhomb. In the case of a Zeeman doublet, we would then have issuing from the rhomb the light of the two components, polarised in planes at right angles to one another. A Nicol prism, standing at a certain angle, will transmit one of these plane polarised beams and cut off the other. Turning the Nicol through 90° will cause the component previously cut off to be transmitted, and the other to be stopped.

Consider a sun-spot at the centre of the solar disc, and suppose it to be produced by a vortex, the axis of which lies on the line passing from the eye of the observer through the spot to the centre of the sun. In these circumstances, if a strong magnetic field is produced by the vortex, the spectral lines due to vapours lying within this field should be widened or transformed into doublets. Moreover, the light of the components of these doublets should be circularly polarised in opposite directions. This would be true if the spot vapours were emitting bright lines, identical in character with those emitted by a radiating vapour between the poles of a magnet. The experiments of Zeeman, Cotton, König, and others, show, however, that dark lines, produced by the absorption of the spot vapours, should behave precisely in the same way as bright lines.

The spectrum of a sun-spot was observed for the first time by Lockyer in 1866. He found that many of the lines of the solar spectrum were widened where they crossed the spot, and the observation of these widened lines has been carried on systematically by many observers ever since. Conspicuous among these observers was Young, whose last observations were made with a powerful grating spectroscope attached to the 23-inch Princeton refractor. This instrument showed that some of the spot lines are close doublets. Dr. Walter M. Mitchell, who at first worked in conjunction with Prof. Young, and later by himself, gave special attention to these double lines, which he found to be particularly numerous at the red end of the spectrum. He called them "reversals," and the existing evidence favoured the view that they were produced by the radiation of a hotter layer of vapours overlying the spot, which would give rise to a narrow bright line at the centre of the widened dark line. True reversals of this kind actually seem to occur in the case of H and K and other lines in the spot spectrum, and it was therefore natural that Mitchell should attribute the similar phenomena of the spot doublets to a similar cause. It was generally supposed that the widening of the dark lines was due to the increased density of the spot vapours. The diverse character of the lines in the sun-spot spectrum is well illustrated by this drawing, which is due to Mitchell. In addition to the ordinary widened and "reversed" lines we find cases where a dark central line is accompanied by wings, others in which lines are thinned or completely obliterated, &c.

(*To be continued.*)

RECENT AGRICULTURAL PUBLICATIONS FROM THE WEST INDIES.

THE imperial Department of Agriculture for the West Indies issue three periodical publications:—(1) the *West Indian Bulletin*, a quarterly scientific journal containing papers or reports by members of the scientific staff, or papers read at agricultural conferences; (2) the *Agricultural News*, a fortnightly paper, published at one penny only, containing short articles in popular language on subjects of importance to planters; (3) a series of bulletins, each containing detailed information on some special subject. In addition, reports are issued on the work done at the different experiment stations on some of the islands, and the Department of Agriculture for Jamaica issues a separate bulletin of its own.

During the present year the last number of vol. ix. of the *West Indian Bulletin* and the first of vol. x. have been published. The timbers of Jamaica are described at some length by Mr. Harris, no less than 108 varieties being dealt with, and a similar article describes 176 trees found in Dominica. Dr. Watts and Mr. Tempany discuss the soils of Nevis in a very luminous paper. Mr. W. Biffen writes on soil inoculation, and describes a number of experiments made in various parts of the West Indies with Prof. Bottomley's cultures. No increase in crop was produced, excepting only in two cases; this result is, of course, quite in accordance with careful trials made elsewhere.

The *Agricultural News* is altogether distinct in type from any other agricultural paper. It consists almost entirely of scientific articles, some original and some quoted from other sources, but all bearing on the problems of West Indian agriculture. With a body of scientific men like the staff of the West Indian departments there is probably no great difficulty in getting "copy," but it is interesting and significant that the "news" should be appreciated by the planters. An interesting economic problem is raised in one of the issues. The West Indies are, of course, almost purely agricultural, yet quantities of food-stuffs are imported. In the Leeward Islands, for instance, the total value of all imports for 1906–7 was 407,251*l.*, of which 151,260*l.* was for food, viz. 46,751*l.* for wheat flour, 13,593*l.* for corn meal, 12,657*l.* for salt pork, hams, and bacon, 9127*l.* for bread-stuffs, 8537*l.* for rice, and 991*l.* for peas and beans. No doubt it is economically sound for these islands to grow for export such staple products as sugar, cacao, cotton, limes, bananas, and to import the above food-stuffs; but in many of the West Indian islands there are men unemployed and land uncultivated; moreover, crops like cotton require some sort of rotation. Why could not some scheme be evolved for raising on the spot the bulk of this imported produce? The question is discussed in a broad, masterly way in an interesting and informing article.

Of the recent pamphlets dealing with special subjects that have reached us, three relate to the sugar-cane. Experiments have been in progress some years in Antigua and St. Kitts to ascertain those varieties of sugar-cane which are likely to give improved yields of sugar, and, at the same time, to show increased resistance to disease. In the manurial trials it is found that sulphate of ammonia or nitrate of soda alone, *i.e.* without potash or phosphate, is the most profitable form of manure for ratoon canes. Sulphate of ammonia proved more useful than nitrate of soda, probably due to its being less liable to loss by leaching. Potash and phosphate still further increase the yield, but not to a sufficient extent to pay for the additional fertiliser. Dried blood did not prove remunerative. Very full details are published in a separate report. Experiments on similar lines are made at Barbadoes; the results are very similar, but the increased yield obtained by the use of potassic manures was profitable.

Jamaica has its own Department of Agriculture and publishes its own bulletin. The new series began in April of this year under the editorship of the director, Mr. H. H. Cousins, and it is well got up and illustrated with very good photographs. Mr. Cousins contributes articles in his usual lucid style on rum, cassava, starch, mangoes, and other important local industries. Mr. Ashby discusses the yeasts of the rum distilleries, and in another article the bacteria of the soil, and Mr. Harris describes the timbers of Jamaica.

THE QUINQUECENTENARY OF THE UNIVERSITY OF LEIPZIG.

THIS year, the year of anniversary celebrations, has been an *annus mirabilis* for other countries than our own. In Germany Leipzig has been commemorating her five-hundredth birthday, and Prof. Wundt, her official historiographer, had a crowded and distinguished audience before him in the theatre at Leipzig, an assemblage including the King of Saxony, the Royal princes, and many learned delegates drawn from all four quarters of the globe; but some notice must be taken of the previous history in order to understand and to preface Prof. Wundt's enthusiastic and interesting discourse.

Charles IV., the first German King of Bohemia, in 1349 established at Prague the first German university. About half a century later, and in the throes of the Great Schism, whilst Wenceslaus was still occupying the Imperial throne, there was a great national and religious revolt in all the Slav domains of the Holy Roman Empire, and in the course of this upheaval the University of Prague was nationalised by the Cechs. Then, in 1409, a small band of German teachers and students left Prague, turned their faces northwards, and founded a new home at Leipzig. Prof. Wundt's address shows how fully he realises that the spirit of those first free emigrants was perpetuated in the great school they established. For in this her voluntary uprising, Leipzig is unique among the universities of Germany; her existence might be confirmed by the princes and electors, and she might acknowledge many benefactions from on high, but she was ever independent of both city and Sovereign. Yet this independence, this tradition of liberty, was sterilising; it rested on an essential immutability; until 1830, when the University had to commit her own suicide—but was spared the public executioner—and became a State institution, she remained scholastic, manacled with fetters of an age outworn.

Prof. Wundt thinks that the present age may witness a change, as at those two epochs when humanism and science forced a reluctant way in. As Leibniz said, "The past has ever been fulfilled by the future." "Wherever we look," says Prof. Wundt, "we see the force of new needs impelling us far beyond the original objects of the universities. The universities arose out of the bosom of the Church. The State was concerned with conserving a class of learned clerics, and thus availed herself of them as schools for the making of a learned officialdom; and thus the State cut herself free from the Church in the settling of the aims of the universities. But nowadays a third power is associated with the State, and is presenting an ever-increasing tale of demands, viz. the community. Society henceforth needs the State as a means of attaining its ends, just as the Church once similarly required the resources of the State." And the modern university will present a more motley and less secluded appearance; it will have to deal with the claims of women to a university education, to admit technical high schools and pupils from *Realgymnasien* to an equality with its original *alumni*, and to extend and expand to suit the manysidedness of modern life. Leipzig, very late in the day, at last had to succumb in the fight against humanism, and had to allow the newer teaching gradually to supersede scholastics. So, too, the University had to approve natural science and the linking of research to scholarship; but the present conflict is not "as of old, a struggle between irreconcilables, of whom only one may win; rather, the task of combining the ideal of the future with the whilom new ideal of culture."

The early centuries of the University are, on the whole, undistinguished. Not even the Reformation transformed it essentially. After the model of Paris, the University was divided into four "nations," each under its dean, the Meiszners, the Saxons, the Bavarians, and the Poles; but all these ancient differences have been swept away; this only remains, that, at every annual election, the statutes of 1554 are entrusted to the new officer, and the benevolent funds for poor students still subsist. Also every professor has, like the mediæval *magister*, a *famulus*! In 1543 Maurice, the great Elector of Saxony, gave the University the old Dominican monastery of St. Paul, which was itself built on the foundations of one of the three castles erected in 1217 to cow the city. There were, as is usual in the story of university life, many town and gown riots, perhaps, as the professor suggests, survivals of the old Bohemian spirit of liberty. The University was a close corporation, rigidly scholastic, with only one faculty, theology, up to which all other branches of knowledge necessarily led; and then, too, "it was the fate of the German university that its development should have begun at a period of the decay of learning." When the sleep of the other universities was being broken by dawning humanism, Leipzig resisted longer than any other; and the University of Leipzig was regarded as an almshouse for irremovable *magistri*, and for some time, during the horrors of the Thirty Years' War, young children were matriculated in large numbers so as to secure them some legal immunity; there were only a few dozen students, so that the almshouse became a nursery as well.

In the eighteenth century the great struggle was, first, to secure admission of the German language for formal purposes, and, secondly, to ally research with study. In 1710 Augustus the Strong granted an observatory, very much in opposition to the University authorities, who, like true scholastics, deemed all teaching should be theoretical. "If a professor made chemical or physical experiments, such were utterly outside his profession. . . . Even an anatomical lecturer did something very supererogatory if, even once a term, he exhibited the position of the entrails to his class. . . ." But the *Universitas Scholastica*—not yet the actual *universitas litterarum*—even in its theoretical teaching, had to be permeated by the modern spirit, and to admit, as subjects, architecture, military science, and so forth, and even, in the *universality* of its strivings, quite technical matters, afterwards more fitly relegated to the polytechnics. Later, at the beginning of the last century, when the University of Berlin was inaugurated, Humboldt's words mark the great change. "Research and teaching must coexist, each in its place, and teacher and pupil must be partners. . . . The strength of the elder mind, more practised, but weaker and more cramped, must act in unison with the spirit of youth, less reliable but more enterprising. With this process of exchange the State must not meddle . . . it must supply the wherewithal and select the right men." So too Schleiermacher. "The teacher must be wholly free and gather round himself a seminary of fellow-seekers, thus constituting scientific research as a means to something greater, namely, a school of character." But Prof. Wundt sees two sorts of dangers ahead. First, that politics may enter into the scholastic world and affect the choice of competent instructors, and, secondly, that university teachers, though they be civil servants, may not recognise the essential differences between them and ordinary State officials, *e.g.* that such rules as promotion by seniority cannot apply to them. Instances of the former peril at Leipzig have been the enforced resignations of Mommsen, Otto Jahn, and Moritz Haupt.

One great reform the University of Leipzig has accomplished. The old foundation, professing to be universal, was little more than an ultra-conservative high-school for Saxony, in which great men found it hard to breathe freely; thus Leibniz was forced outside. But the modern State institution is at least German, and not "particularistic." The teachers are drawn from every part of Germany and German-speaking Austria, and the University, if not international, as in olden time it professed to be, is a national school of a united nation.

The early attendances at the University are difficult to gauge. The practice of matriculating children, of not including teachers and students who came in *extra ordinem* (*i.e.* not as members of the corporation), the irregularity of attendance (varying for the terms; in the winter the students mostly went home), and the inadequacy and vagueness of the old lists, all these causes make any accurate computation impossible. The average is from 350 to 450, rising between 1609 and 1629 to 800, sinking in 1634 and 1645 to less than 100. This severe fall more or less corresponds with the Thirty Years' War. Another noticeable drop (1520–40) may tentatively be accounted for by the superior attractiveness of Wittenberg (where Luther was staying) and the troubles of the Reformation. After the establishment of the present Empire the numbers rose in ten years from 700 to 2000, and in 1908 stood at more than 2300.

Prof. Wundt's long address, which is published by Mr. W. Engelmann, of Leipzig, leaves something to be desired. He gives few details as to the modern extensions of the University, of its new buildings, of the student associations, and in his estimate of the coming problems he expresses himself indecisively, perhaps discreetly. It would, too, have been interesting to be able to correlate better the progress of German history and the developments of this ancient corporation; but perhaps there is little more to be said, for, until the revolutionising change of 1830, there was little alteration. But a university with so high a claim to veneration for antiquity, so great a repute for modern achievement, could hardly have found a more distinguished commemorator.

INTERNATIONAL CONGRESS ON PURE FOODS AND ALIMENTARY SUBSTANCES.

THE second International Congress on Pure Foods and Alimentary Substances, held in Paris on October 17–24, will be memorable as having brought together more than 2000 delegates and members from all parts of the world. The actual number of countries represented was twenty-eight, and these included States so remote as China, Japan, Uruguay, Mexico, and Brazil. All the European States, as well as America and the British colonies, were fully represented.

The British delegation was a representative one, and included delegates from various learned societies and other associations interested in a pure food supply. The meetings were held in the College of Medicine, Paris, which was kindly placed at the disposal of the congress by the faculty, and the various class-rooms, together with the commodious amphitheatre, were taxed to their full capacity to accommodate all those present. Indeed, on the official opening day, October 18, it was quite impossible to find room for half the members who desired to hear the speeches. The address of welcome was given by M. Ruau, Minister of Agriculture of France, who dwelt on the great work being carried on by the White Cross Society of Geneva, under the auspices of which the second International Food Congress was held. The White Cross Society was called into existence as a companion organisation to the Red Cross Society, the efforts of which have proved so successful in mitigating the horrors of war. It is the mission of the White Cross Society to try to ameliorate the evils of our modern social system, and in no respect is this more needful than in connection with the food supply.

Prof. Bordas, chief of the customs laboratories of France, as president of the congress, reminded the members present that the first congress, which was held at Geneva, had defined what should be the constitution of pure food, primary products in connection with drugs, and various alimentary substances, all of which had been set forth in the *Comptes rendus*. It would be the business of that congress to continue these definitions and determine precisely what operations should be allowable in the handling of such substances. When that was complete it would then be necessary to try to unify analytical methods or show exactly what relation one analytical process bore to another, so that the results attained would be comparable equally. When such a basis of comparison was arrived at, it would then be easy to place the whole department of the supply of food and alimentary substances under legal control in all countries.

The work of the congress was divided up into various sections, the duty of which it was to come to definite conclusions in connection with various substances and report such decisions to the section of hygiene, which formed a kind of court for reviewing the work done in other departments.

The sections included:—(1) drinks and beverages, wines, liqueurs, cider, perry, beer, vinegar; (2) bread, flour, pastry; (3) confectionery, honey, sugar, sugar preparations, cocoa, chocolate; (4) spices, tea, coffee, mustard, salt; (5) dairying, milk, cream, condensed milk, butter, cheese, eggs; (6) charcuterie, the meat industry, edible fats, preserved provisions, preserved fruits and vegetables, sausages; (7) primary products in connection with drugs, essential oils, chemical products; (8) medicinal and other mineral waters, ice.

The consideration of such a formidable list necessarily meant continuous hard work, and it is only fair to say that the attendance at the sections was everything that could be desired, and the department of hygiene was crowded from first to last, it being estimated that in it alone the average attendance exceeded 500.

It would not be desirable to attempt to review the various discussions in detail, suffice it to say that the definitions were completed, and, as the president announced, will be published as soon as possible in French, German, and English. It may be of interest, however, to refer to some of the more notable decisions.

Bread was declared to be the product resulting from the baking of dough made from pure wheat flour, with the addition of yeast, water, and salt. Any other product meant as a substitute for bread should not bear the name, and its composition should be declared at the time of sale. It was subsequently declared that the addition of baking powder, bicarbonate of soda, and tartaric acid were quite permissible and regular operations. Alum was entirely prohibited.

Coffee was clearly defined as being only worthy of that name when derived from coffee berries and when free from any foreign mixture, such as chicory or any other substance. Cocoa, on the other hand, was not so easily defined. Long discussions on the composition of this product took place in the section, and it was agreed that it would be better to refer the matter to an international commission of experts. The main question was as to whether the addition of alkali to cocoa was justifiable or not. The large manufacturers said that it was unnecessary, but the small makers, who were in the majority, held to the view that not only was it allowable, but it was necessary, so as to enable them to produce a cheaper cocoa than that sold by the large makers, and at a cheaper price. They asserted that the buyers for whom they catered belonged to a class which could not afford the high prices asked by large manufacturers. To prohibit the use of alkali meant the practical extinction of the small makers and the creation of a vast monopoly in the hands of a few. The discussions on the subject in the hygienic section were prolonged and sometimes very heated, but in the final issue it was agreed that 2 per cent. of alkali should be allowed. An international commission will consider the whole matter, as it appears that cheap cocoas are not only sophisticated with alkalis, but additions, which are simply adulterations, are common. It is strange to hear, for example, that one manufacturer uses paraffin wax in his produce!

If the discussions on cocoa were animated, so also were those on butter. At the Geneva congress there seemed to be a feeling that the definition of pure butter was a political rather than a hygienic question, and the voting seemed to be between the fresh butter and the salt butter makers. Owing to the greater attendance at the Paris congress there was a greater body of opinion, hence the discussions were more prolonged, and, for that matter, more interesting. The first question was as to the empirical standard of 16 per cent. of water, which, it was declared, was too low for general purposes. It was finally raised to 18 per cent.

The next question was in connection with the use of preservatives, and it was shown that it was not possible to conduct an export butter trade over any great distance without the addition of some boron preservative. This addition was allowed, and classed as a regular operation (*opération régulière*), which means that it is now considered as necessary in the making of some kinds of butter as is the addition of salt, and need not, therefore, be declared. Colourings for food, confections, and liquids came in for considerable attention, and it was found impossible to resist the argument that the sale of many alimentary products depended to a large extent on their appearance, and the use of harmless colours was therefore permitted. Twenty anilines were specifically mentioned as being innocuous, and they embrace every shade used for food purposes.

The discussion of ice elicited quite a display of feeling, and an acceptable definition was not arrived at without some difficulty. It was finally agreed, however, that there were two kinds of ice, namely, manufactured and artificial. The manufactured article should be produced only from sterilised or town's water. Natural ice could only be admitted for addition to, or for bringing in contact with, foods, when gathered from lakes, rivers, or canals under proper sanitary control.

Medicinal mineral waters did not emerge from the discussions well. It appears that there is quite an industry in manufacturing these and sending them out into the world under apparently genuine labels, and the "source naturelle," or natural spring, is too often the town supply of water to which a small percentage of alkaline salts is added! To control fraud such as this is difficult, and nothing short of making it a penal offence would be of much use.

In connection with drugs, a long discussion ensued upon the presentation of a brochure by Mr. C. Umney, in which he set forth the desirability of instituting international control of specific substances, and it is not unlikely that, as the matter is of such world-wide importance, an international commission may be appointed to study the whole question in detail.

These references will show that the work accomplished was very great, for it must be borne in mind that each subject on the programme had to be discussed and resolutions arrived at. The manifest pains which were taken to arrive at correct definitions impressed those present.

The feature of this congress was earnestness and a strong desire to coordinate practice with hygienic requirements, and when the *Comptes rendus* are published it will be seen how very thoroughly the work was carried out.

It has not yet been decided where the next congress will be held. The choice lies between Rome, Brussels, and London, but a decision cannot be arrived at until later.

It may be mentioned that much hospitality was shown to the visitors. The city of Paris gave a reception at the Hôtel de Ville, and the Minister of Finance at the Ministry. Various visits to notable food factories, such as that of Messrs. Potin and the chocolate factory of Messrs. Menier, were arranged. Parties also visited the brewery of Messrs. Karcher, the Gobelins lace factory, and Sèvres porcelain works. Amongst those who dispensed lavish private hospitality were Madame and M. Paul Bolo, to whose initiative the White Cross Society of Geneva owes its origin, and whose generosity enabled it to call the first congress together at Geneva last year.

LOUDON M. DOUGLAS.

EDUCATION AT THE BRITISH ASSOCIATION.

THERE can be no gainsaying the fact that education received quite its fair share of attention at Winnipeg this year. Readers of NATURE have already had an opportunity of considering the words of warning in Sir J. J. Thomson's presidential address to the association on the excessive competition for scholarships now confronting the student of every grade in England, and on the evils which the consequent premature specialisation brings in its train—the dulled enthusiasm for knowledge and the inadequate literary culture. In the physiological section, also, Prof. E. H. Starling shed a fresh light on the meaning of the word by applying to it the conception of man as the last result of an evolutionary process.

In the Educational Science Section itself, Dr. Gray's presidential address, printed in NATURE of October 7, was concerned with "The Educational Factors of Imperialism," and in the course of it he developed an attack on the "grand old fortifying classical curriculum" with a boldness remarkable in one who is at the head of an English public school, and, as Prof. Armstrong said, is one of the most successful teachers of Greek we have.

Manitoba lags behind its younger sisters, Alberta and Saskatchewan, in that elementary education is not by law compulsory, and the pronouncement made by Dr. Kimmins, one of the vice-presidents of the section, in favour of compulsion probably attracted as much outside attention as any utterance in the section. For two days the blackboards outside the *Free Press* office, which appear to constitute the principal reading of many inhabitants of Winnipeg, informed the constant crowd that "Dr. Kimmins had expressed astonishment that education was not compulsory in Manitoba."

To the regular attendants of the section, however, the contributions of the two American vice-presidents, Prof. Hugo Münsterberg and Principal J. W. Robertson, were the outstanding features of the meeting.

Prof. Münsterberg spoke at some length on the last day of the meeting, and to a good audience, on the relations of education and experimental psychology. He began by drawing a striking contrast between the attitude of teachers here and in America towards psychology. In England psychology is neglected, and the teacher is like the farmer who turns his back on chemistry—his methods remain clumsy and old-fashioned. In America, on the other hand, the value of the subject is overestimated, and the teacher commits the grave mistake of subordinating the whole of his art to scientific psychology; but a science gives us the means, not the aim. The psychologist regards the inner life as the physicist regards the outer. He shows us how the pupil's mind imitates; he cannot tell us what is worthy of imitation. It is to ethics we must look to give us our goal before we apply to psychology for the means to reach it.

Again, the psychologist is seeking the relation of cause and effect, and for that he must analyse personality. The child's mind is to him a combination of elements, as the physical thing is a combination of atoms; and so psychological truth differs from the truth of life. The child, for the educator, is a unity to be understood, not a bundle of conditions to be described. The teacher must beware of any tendency to inhibit those emotional responses of personality to personality. Tact and sympathy and love and interest are the things which matter in educating the young.

Yet, if its dangers are well understood, the knowledge of experimental psychology ought to be at the disposal of the teacher just as experimental physics ought to be familiar to the engineer. Psychology in the past has been a strictly theoretical science, having little or no connection with practical needs; but in the last decade the connections have been made; the practical problems have been studied in the laboratory in the light of psychological facts. There is a body of psychology applied to education which the teacher can use with safety.

Of this applied psychology Prof. Münsterberg gave several interesting examples drawn from his own laboratory practice. He told us how, by experimenting with nonsense material, the effect upon remembering of repetition, of a lengthened time interval between hearing and recollecting, of reading as against writing and saying, had all been studied. He showed that the learning process is not coterminous with the process of taking in, but that a period of rest, in which the impressions settle, as it were, and organise themselves with the previous content of the mind, is requisite. He laid it down that piecemeal learning is an illusion, and that, within certain ascertainable limits, the larger the group of impressions the better they are remembered. Finally, he pointed out that it is possible to relate individuals to certain definite types, as, for instance, those whose memory is visual and those in whom it is acoustical, and indicated the relevancy of the facts, not only to the educational process, but also to the selection of a calling for the child, since every calling demands certain characteristic traits.

Dr. J. W. Robertson, the second American vice-president of the section, is the first principal of MacDonald College, which has been established at St. Anne de Bellevue, a few miles from Montreal, at the west end of Orleans Island, through the generosity of Sir William MacDonald. The college buildings alone cost nearly half a million dollars, and, standing as they do immediately north and south of the two great trunk lines of Canada, which at this point run side by side, cannot fail to attract the attention of every traveller to the western prairies. They are, indeed, a worthy monument of their founder and of the genius of the man who inspired him to build this great house of education.

Dr. Robertson addressed the section on the history and aims of the college. He described the college as an effort for the betterment of rural life in Canada. We are face to face here, he said in effect, with problems which are peculiar to ourselves—problems due to our youth, to our vast stretch of territory, to the great potential value of our resources, to the broad stream of foreign blood which is pouring into our citizenship. Wealth may come, is coming with great rapidity, but real progress and stability in national life keep side by side with progress in intelligent labour, and that depends upon education.

MacDonald College has grown out of a desire to help the rural population to build up the country and to make the most of it and of themselves. The rural school must be adjusted to the needs of the people; it must have a bearing on the life interests, the occupations, and the opportunities of the locality. From the course of study in many rural schools to-day you would not suppose that the fathers had any concern with the soil, with crops or animals. At MacDonald College we instruct and train for the three fundamental mothering occupations which nurture the race, first, farming, whereby man becomes a partner with the Almighty, and through cooperation with nature obtains food and shelter and clothing; secondly, home-making; thirdly, the teaching of the children. The training of leaders for these three fields of endeavour is being carried on in close correlation. Until recently, the teachers and the agricultural students were segregated for training, and the courses of study of neither class contained much which identified education with the activities of the home. Now the home, the farm and the school are finding common ground, to the great advantage of all three.

We are all part of nature; our lives, the transient and the eternal, are sustained by natural processes under natural laws. The study of nature, then, must lie at the root of all education. Nature-study, too, deals with the facts and principles on which a systematic study of agriculture can be founded; and next to nature-study comes manual training, which is similarly a basis for technical and industrial education. Every boy and girl should go through a course of manual training. Think of its value in the making of character. How many men there are who need the stimulus of others' approval to keep them in the right way. Here is something which the boy can assess for himself; he does not need the teacher's blue pencil to tell him whether his woodwork is right or wrong. He judges it for himself and judges himself—"that is not so good as I can make it." See, too, how it teaches the lesson of all lessons the most important, the lesson of consequences—"the joint will not fit because I did that wrong."

If the people starve the schools and colleges, the schools and colleges will retaliate by letting the people starve mentally, then morally, and in a measure materially too. "Once I saw a field of which the owner said, 'I let the crop take care of itself, and in three years there were only two small heads of wheat among the weeds.' For the bare maintenance of human life there is need for practical education." It is hopeless in a bald summary to attempt to recapture the enthusiasm, the intimacy, and the individuality of Dr. Robertson's address. Those who heard him will not soon forget the experience.

A useful discussion upon moral education was opened by Prof. L. P. Jacks. The demand for moral training has been reinforced by the growth of the imperial idea, which is awakening the national conscience and confronting the individual citizen with enlarged responsibilities. Morality cannot be made one among a number of set subjects; what is needed is the idea of an "end" under which the purposes of life may be coordinated. Loyalty to the State is such a principle. Neither can the virtues be taught on a fixed pattern; the attempt to do so leads inevitably to reaction against the idea of morality. The teacher must be content to put the truths of their environment before young minds in such a light that the facts themselves, when so explained, become incentives to morality. Mr. Hugh Richardson followed with a plea for a scientific investigation of methods and results. He pointed out how extraordinarily little evidence there is as to what results have been produced, still less is there any evidence as to which processes have produced which results. The speakers following agreed with Prof. Jacks that direct moral training was of little worth.

Prof. Münsterberg, however, thought that teachers should keep the ethical "end" always before them. There are tendencies in education to-day which are bringing weakness of character in their train. It is not wholly good that the methods of the kindergarten should be allowed to creep up the primary school and the elective systems of the high school to descend to it. The problem of education to-day is the cultivation of the power of voluntary attention. The child is naturally attracted by what is loud and bright and shining. If everything is made easy and pleasant for him as a child, as a man he will always remain in thraldom to the momentarily attractive; he will let things slide. The good life is neither easy nor pleasant; the things that matter are not loud and bright and shining.

A discussion which attracted much local interest was initiated by Dean Wesbrook, of Wisconsin, on university education, in which Mr. W. A. McIntyre, principal of the

Provincial High School and Normal School, and Principal Murray, of the University of Saskatchewan, took part. The University of Manitoba at present is hardly more than a group of science faculties supplementary to the arts courses provided in the affiliated denominational colleges. Alberta and Saskatchewan are laying the foundations of what will one day be strong State universities, and Dean Wesbrook did not disguise his opinion that this was the right course to pursue. In the course of the discussion Mr. C. R. Mann, secretary of Section L of the American Association for the Advancement of Science, spoke of the direct influence which the needs of the community at large must have upon the work of a State university.

Mr. W. M. Heller, a vice-president of the section, opened a symposium on practical work in schools with a paper on the report of the committee on practical studies, which was presented at Dublin last year. Dr. Kimmins contributed a paper on the London trade schools; Miss Lilian Clarke an address, illustrated with the lantern, on scientific nature-study in secondary schools; and Mr. W. Hewitt read a thoughtful paper on practical work in continuation schools and evening classes. Mr. Walter Sargent, of Chicago University, claimed a place in the primary-school curriculum for manual training for the purposes of industrial education. In many localities in America 80 per cent. of the children leave before the end of the primary course. These children drift into unskilled occupations, and spend often two or more years in employment which awakens no industrial interest and offers no vocational outlook. For these children an optional course should be provided, planned definitely to promote industrial efficiency. Those who argue that this would abridge the period of cultural education, already too short, were reminded that no sharp line can be drawn between cultural and industrial education. "Most of the activities which have raised men from savagery involved a utilitarian test of their result. Utilitarian is a word the meaning of which becomes more inclusive with advancing civilisation."

In the discussion on the teaching of geography Profs. Dodge, Johnston and Brigham, Mr. Chisholm, and Dr. C. H. Leete took part. To one trained in geography on the old topographical method, or want of method, who is watching its gradual displacement by the more scientific regional geography, it was novel to hear that in the high schools of the United States there is practically no serious study of regional geography. The physiographical text-books in use in America are admittedly much in advance of our own, but the advance appears to have been at the expense of the student, who, after his fourteenth year, is condemned to the study of classifications principally of land forms with reference to their origin rather than to their effect upon human and animal life. Happily, there are signs of change. Prof. Brigham's account of how he was driven back upon topography pure and simple in his endeavours to aid a young student of his own kin who was floundering in a text-book on physiography (very likely his own book!) amused his English hearers, and, it may be hoped, was not lost upon some of his brother professors across the water.

The closing discussion, on education as a preparation for Canadian life, was opened by the president, who proposes to test his theories on a farm for English public-school boys which he is establishing in the neighbourhood of Calgary. He was followed by Mr. S. E. Lang with an account of high-school work in agriculture. Miss Benson described the household science course at Toronto University, and Miss Oakley gave an account of the similar course at King's College, London. Mr. Eggar spoke of the value of school games. If the principle that it was better to lose a game than to win it unfairly were true, then school games had a grand moral as well as a physical effect.

An account of the proceedings would be incomplete without some mention of the collection of brush drawings by pupils of the Village Hall School, Weybridge, which Mr. T. S. Marvin's pertinacity had brought intact through the Canadian customs. This interesting exhibit had been designed to help children in Canadian schools to realise the conditions of child life in England. There were series of brush drawings illustrating rooms in English houses, methods of going to school, bric-à-brac, portraits of the artists, and so on. Nature-study was illustrated by sketches of plants characteristic of the different months, and studies of the seasonal growth and decay of common wild flowers. The purpose of the drawings was excellent, and was carried out in a charming fashion. The nature-study work reached a high standard of accuracy, and almost all the drawings showed great artistic merit. It is pleasant to think that the collection will remain in Manitoba to pay a double debt—as a token to the educators of the province of our gratitude for their efforts on our behalf and as a reminder to the children of their child cousins on the other side of the sea.

CONFERENCE OF DELEGATES OF THE CORRESPONDING SOCIETIES, BRITISH ASSOCIATION.

IF the annual conference of delegates of the local societies in correspondence with the British Association had been held at Winnipeg, it is not likely that many societies in this country could have sent representatives. It was consequently decided to hold an autumn conference in London, as was done after the South African meeting four years ago. Accordingly, a conference was held on Monday and Tuesday, October 25 and 26, in the rooms of the Geological Society at Burlington House, under the chairmanship of Prof. A. C. Haddon, F.R.S. As many of the delegates from the provinces arrived in London on the preceding Saturday, an official visit to Kew Gardens was made on Sunday afternoon, when the delegates were received by Lieut.-Colonel Prain, F.R.S., and Dr. O. Stapf.

The conference was opened on Monday morning by an extemporaneous address from the chair, in which Dr. Haddon urged the local societies to carry out observational work of an original character. Regional surveys might well be undertaken. Intensive work in the special areas within range of the activities of the respective societies would ultimately lead to a close knowledge of the whole country. Dr. H. R. Mill's detailed study of a district in the south-east of England was naturally held up as a model; and reference was also made to the excellent work of Prof. A. W. Clayden on the origin of the scenery of Devonshire, and to that of Prof. W. W. Watts on Charnwood Forest. Turning to our rivers as a suitable subject for local study, Dr. Haddon referred to the work of Prof. W. M. Davis, remarking, incidentally, that it was rather strange an American should have to teach us how to read the story of our own streams. With regard to zoology, the chairman explained that when he worked under F. M. Balfour he was an enthusiastic embryologist. Notwithstanding the advance of special work in the higher departments, there was still ample room for the amateur in zoology. Anthropometry, again, was a subject that might well be taken up by the local societies.

A paper on national anthropometry was read by Mr. J. Gray, the secretary of the anthropometric committee of the British Association. He explained the methods of measurement, and exhibited on the screen the excellent figures prepared by the late Prof. Cunningham to define the exact points of reference on the living subject, from which measurements should be taken. The instruments used are inexpensive and their use not difficult, so that, in the absence of a national system of anthropometry by a Government department, the natural history societies in each county might well undertake the work. A demonstration was given, and many of the delegates were measured. Attention was also directed to the various means now used to estimate quantitatively certain mental faculties.

A prolonged discussion was initiated by Prof. Meldola, F.R.S., who desired to elicit from the delegates their opinion as to the expediency of establishing a fund, with Government aid or otherwise, for the purpose of assisting scientific societies in the publication of original work. Many societies were crippled by insufficient means, and it was believed that much good work in the country remained unpublished, or, if published, was insufficiently illustrated, whilst in many cases the proportion of income expended on publications was so great as to hinder the activity of the societies in other directions.

Sir Alexander Pedler, F.R.S., explained how the British Science Guild had sought to relieve the scientific societies by endeavouring to obtain a reduction in the rate of postage of their publications, but he much regretted that the Postmaster-General, though sympathetic, could not see his way to grant such relief. Some of the delegates suggested a renewal of the application, but it seemed unlikely that this would be successful. The general question of founding a publication fund was discussed by representatives of many scientific societies, including the Chemical, the Royal Astronomical, the Zoological, the Entomological, the Royal Anthropological Institute, and the Institution of Mining Engineers.

In a paper on the financial position of our local societies, Mr. John Hopkinson sketched the history of the Hertfordshire Natural History Society, and showed how a society which had always struggled with a small income had yet managed to publish excellent original work.

Although the opinion of the conference was generally favourable to the formation of a publication fund, a few speakers expressed the opinion that it would be inexpedient to take any step which might tend to increase the publications of local societies, inasmuch as the mass of such literature was already embarrassing to the bibliographer.

On the afternoons of Monday and Tuesday the delegates visited, under scientific guidance, the Natural History Museum and the Zoological Gardens.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An election to the Clerk-Maxwell scholarship will take place at the end of this term. Candidates are requested to send in their names to Sir J. J. Thomson on or before December 1.

Dr. G. H. F. Nuttall has been re-elected to the Quick professorship of biology. Mr. J. S. Gardiner has been elected to the professorship of zoology and comparative anatomy. Mr. E. O. Lewis has been appointed demonstrator of experimental psychology until Michaelmas, 1911; and Mr. D. G. Lillie has been elected to a Hutchinson research studentship for natural science.

Mr. H. F. Tiarks has supplemented Messrs. J. Henry Schröder and Co.'s gift of an endowment of a professorship of German by placing at the disposal of the University the sum of 5000*l.* for the endowment of one or more scholarships for the encouragement of the study of German in the University.

IT is announced in *Science* that Mr. Andrew Carnegie has subscribed 20,000*l.* to McGill University as a part of the general fund of 400,000*l.* which friends of the University are trying to raise.

THE Black Bear Press, Cambridge, has sent us a copy of the first issue of a new weekly magazine, the *Gownsman*, which is to be a record and comment of university life. The contents range over every department of university activity—academic, athletic, social—and the periodical should appeal to all Cambridge men, past and present. With this first issue is published, as a supplement, an excellently reproduced portrait of Sir Joseph Thomson, F.R.S. The price of the new publication is 2*d.* weekly.

THE annual meeting of the Association of Teachers in Technical Institutions will be held on November 6 at St. Bride Institute, Fleet Street, E.C. The chair will be taken at 3 p.m. by Mr. J. Wilson, who is the president of the association for the coming year. The report of the council will contain an abstract of the educational and professional work accomplished during the year. The educational work comprises the consideration of such questions as syllabuses in such subjects as applied mechanics and electrical engineering, the training of craftsmen, the preliminary training of technical students, and the Royal Commission on university and higher education in London.

IN his inaugural address, at the beginning of the present session, the president of Harvard University, Dr. A. Lawrence Lowell, discussed an ideal college training from three points of view. He considered the highest development of the individual student, the proper relation of the college to the professional school, and the relations of the students to one another. Each line of thought led him to the same conclusion. The best type of liberal education in our complex modern world aims at producing men who know a little of everything, and something well. The essence of a liberal education, said Dr. Lowell, consists in an attitude of mind, a familiarity with methods of thought, an ability to use information rather than a memory stocked with facts, however valuable such a storehouse may be. No method of ascertaining truth, and therefore no department of human thought, ought to be wholly a sealed book to an educated man. It has been truly said that few men are capable of learning a new subject after the period of youth has passed, and hence the graduate ought so to be equipped that he can grasp effectively any problem with which his duties or his interest may impel him to deal. In the present age some knowledge of the laws of nature is an essential part of the mental outfit which no cultivated man should lack. He need not know much, but he ought to know enough to learn more. To him the forces of nature ought not to be an occult mystery, but a chain of causes and effects with which, if not wholly familiar, he can at least claim acquaintance; and the same principle applies to every other leading branch of knowledge.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 26.—M. Bouchard in the chair.—E. L. **Bouvier**: The phenomena which characterise the change of nest in the ant *Messor barbarus*. A detailed account of the curious habits of these ants when exchanging nests.—M. **Gouy**: The constitution of the electric charge at the surface of an electrolyte.—Armand **Gautier**: Remarks on the second International Congress for the Repression of Fraud in Food and Drugs, held at Paris, October 18 to 23.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the second quarter of 1909. Observations were possible on sixty-three days, the results being summarised in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Charles **Nordmann**: The temperature of β Perseus (Algol). Taking 6000° as the temperature of the sun, the application of Planck's law leads to 22,900° as the temperature of Algol. This is nearly identical with the temperature (23,800°) found previously by a totally independent method.—M. **Javelle**: Halley's comet. Observations of the comet made with the large equatorial at Nice. On October 12 it appeared as a small round nebulosity, $10''$ to $15''$ in diameter, with a central nucleus of the fourteenth to fifteenth magnitude.—R. **Jarry-Desloges**: Observations on the surface of the planet Mars. Two diagrams accompany this paper, showing the details perceived during July, August, and September, 1909.—G. **Athanasiadis**: The influence of temperature on the phenomena of polarisation in the electrolytic valve. The potential difference, producing a definite current in the electrolytic valve, diminishes as the temperature increases.—L. **Gay**: The vapour pressure of mixed liquids. A new demonstration and generalisation of the formula of Duhem-Margules.—G. **Belloc**: The emission of gases by heated metals. A definite volume of gas can be extracted by heating a metal such as steel to a definite temperature in a vacuum. If the metal is allowed to cool, the vacuum being maintained, a re-heating to the same temperature after an interval of some days gives rise to a fresh amount of gas, and this process can be continued; even after seven heatings small amounts of gas continue to be evolved.—Maurice **Coste**: The transformations of selenium. Exact measurements of the density of selenium submitted to various treatments have been made.—E. **Cornec**: Cryoscopic study of the neutralisation of some acids.—Maurice **Barrée**: The points of transformation of the copper-aluminium alloys as determined by a study of the variation of electrical resistance with temperature.—Georges **Darzens** and M. **Rost**: Hexahydrophenylacetylene and hexahydrophenylpropiolic acid. Starting this hexahydroacetophenone,

$C_6H_5.CO.CH_3$, this was converted into $C_6H_{11}.CCl:CH_2$ by the action of phosphorus pentachloride, and from this hexahydrophenylacetylene is obtained by the action of potash. The sodium derivative of this, with carbon dioxide, gave sodium hexahydrophenylpropiolate, some derivatives of which are described.—H. **Arsandaux**: Contribution to the study of the laterites.—Marin **Molliard**: Can the amines serve as food for the higher plants? Contrary to the results of Ville and of Lutz, the author's experiments lead to the conclusion that none of the amines can act as food substances for the higher plants.—I. **Borcea**: The origin of the heart, the vascular migratory cells, and the pigmentary cells in the Teleostea.—A. **Imbert**: The fatigue produced by rapid movements.—C. **Fleig**: The action of radio-active mineral waters and of artificial serums on the survival of organs or isolated cellular elements of the body.—Maurice **de Rothschild** and Henri **Neuville**: Remarks on the okapi.—A. **Monvoisin**: The acidity of the milk of tuberculous cows. The low acidity of tuberculous milks depends principally upon the diminution in the amount of casein present.—Alfred **Angot**: The earthquake of October 20–21, 1909. The seismograph records at the Parc Saint-Maur Observatory indicate that this earthquake, no mention of which occurs in the newspapers, must have been very violent. Its epicentre was probably in the Himalayas or neighbouring mountainous regions.—E. A. **Martel**: The subterranean river of Labouiche or La Grange (Ariège).—V. **Crémieu**: A new determination of the Newtonian constant. The torsion-balance method, described in a previous paper by the author, gives a value of $K = 6{\cdot}674 \times 10^{-8}$, the accuracy estimated being of the order of 1 in 10,000.—H. Hildebrand **Hildebrandsson**: Some remarks on the temperatures of summer in various parts of Europe.

CALCUTTA.

Asiatic Society of Bengal, October 6.—J. C. **Brown**: Stone implements from the Tongyueh district, Yünnan Province, western China (with a short account of the beliefs of the Yünnanese regarding these objects). A description of a representative series of twelve stone implements selected from numerous specimens recently examined in Tongyueh is given. Nine of these specimens are fashioned from varieties of jadeite, the other three being cut from red slate-like, white quartzite, and igneous rocks. The Yünnanese attribute a celestial origin to these stones, which they believe to possess occult medicinal properties and to be efficacious in the treatment of obdurate diseases in which the medical treatment has failed to produce any beneficial results. Descriptions of the specimens are subjoined.—H. E. **Stapleton**: (1) An alchemical compilation of the thirteenth century A.D.; (2) contributions to the history and ethnology of north-eastern India, i.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 4.

ROYAL SOCIETY, at 4.30.—(1) The Development of *Trypanosoma Gambiense* in *Glossina palpalis*; (2) A Note on the Occurrence of a Trypanosome in the African Elephant: Colonel Sir David Bruce, C.B., F.R.S., Captains A. E. Hamerton and H. R. Bateman, R.A.M.C., and Captain F. P. Mackie, I.M.S.—On the Perception of the Direction of Sound: The Lord Rayleigh, O.M., F.R.S.—The Diffraction of Electric Waves: Prof. H. M. Macdonald, F.R.S.—On the Mechanism of the Absorption Spectra of Solutions: Robert Houstoun.—(1) Note on the Spontaneous Luminosity of a Uranium Mineral; (2) The Accumulation of Helium in Geological Time, II: Hon. R. J. Strutt, F.R.S.—On the Physical Properties of Gold Leaf at High Temperatures: J. C. Chapman and H. L. Porter.—The Dimensions and Function of the Martian Canals: Dr. H. C. Pocklington, F.R.S.

LINNEAN SOCIETY, at 8.—Some Account of the Field-botany of Namaqualand, Damaraland, and South Angola: Prof. H. H. W. Pearson.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address: C. E. S. Phillips.

FRIDAY, NOVEMBER 5.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Huxley Memorial Lecture. The North European Race: Prof. G. Retzius.

MONDAY, NOVEMBER 8.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Journeys in Bhutan: J. Claude White.

TUESDAY, NOVEMBER 9.

ZOOLOGICAL SOCIETY, at 8.30.—Some Living Shells, their Recent History, and the Light They Throw on the Latest Physical Changes in the Earth: Sir Henry H. Howorth, K.C.I.E., F.R.S.—The Asiatic Fishes of the Family Anabantidæ: C. Tate Regan.—On a Small Collection of Mammals from Egypt: J. Lewis Bonhote.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Single-phase Electrification of the Heysham, Morecambe and Lancaster Branch of the Midland Railway: J. Dalziel and J. Sayers.—The Equipment and Working-Results of the Mersey Railway under Steam and under Electric Traction: J. Shaw.—The Effect of Electrical Operation on the Permanent-Way Maintenance of Railways as Illustrated on the Tynemouth Branches of the North-Eastern Railway: Dr. C. A. Harrison.

THURSDAY, NOVEMBER 11.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Vacuolation of the Blood-platelets—An Experimental Proof of their Cellular Nature: H. C. Ross.—Further Results of the Experimental Treatment of Trypanosomiasis—being a Progress Report to a Committee of the Royal Society: H. G. Plimmer and Captain W. B. Fry.—*Hillhousia mirabilis*, a Giant Sulphur Bacterium: G. S. West and B. M. Griffiths.—The Modes of Division of *Spirochaeta recurrentis* and *S. duttoni* as observed in the Living Organism: H. B. Fantham and Miss A. Porter.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—(1) The Ordinal Relations of the Terms of a Convergent Sequence; (2) The Application to Dirichlet's Series of Borel's Exponential Method of Summation; (3) Theorems relating to the Summability and Convergence of Slowly Oscillating Series: G. H. Hardy.—Notes on Synthetic Geometry: Prof. W. Esson.—Kummer's Quartic Surface as a Wave Surface: H. Bateman.—The Green's Function in a Wedge, and Other Problems in the Conduction of Heat: Prof. H. S. Carslaw.—The Envelope of a Line cut Harmonically by two Conics: J. L. S. Hatton.—On a Case of q-Hypergeometric Series: Rev. F. H. Jackson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presidential Address: Dr. Gisbert Kapp.

FRIDAY, NOVEMBER 12.

PHYSICAL SOCIETY, at 8.—On the Absorption Spectrum of Potassium Vapour: P. V. Bevan.—Some Further Notes on the Physiological Principles underlying the Flicker Photometer: J. S. Dow.—Exhibition of a Colour-perception Spectrometer: Dr. F. W. Edridge-Green.—Tables of Ber and Bei and Ker and Kei Functions, with Furthur Formulæ for their Computation: H. G. Savidge.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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THURSDAY, NOVEMBER 11, 1909.

THE INTERNAL COMBUSTION ENGINE.

The Gas, Petrol, and Oil Engine. By Dugald Clerk, F.R.S. Vol. i. New and revised edition. Pp. ix+380. (London: Longmans and Co., 1909.) Price 12*s.* 6*d.* net.

MR. DUGALD CLERK originally published this book under the title of "The Gas Engine" in 1886. Ten years later it reappeared in enlarged form as the "Gas and Oil Engine." It has now been found necessary, the author tells us, to re-write practically the whole of it, and in doing so the further change of dividing it into two volumes has been made. This is in itself evidence of the development of science and practice that has taken place during the last twenty-three years. The two new volumes are to be called "The Thermodynamics of the Gas, Petrol, and Oil Engine," and "The Gas, Petrol, and Oil Engine in Practice." It is the first of these volumes which is now issued. It is ostensibly a book on the thermodynamics of the gas engine, and it is as such, therefore, that it must be examined and discussed. We may say at once that it is quite unlike any other book on thermodynamics that we remember to have read. Its appeal must be to the comparatively small number of engineers and physicists who are familiar alike with modern practice in gas-engine work and with some of the most recent results in physics. To the experimenter in this important field of work, it will be invaluable as containing in compact form a record of the latest experiments as well as an occasional commentary upon them from the author's standpoint.

It interested us to compare the present volume with Mr. Dugald Clerk's book on the gas engine issued in 1896. We were the more interested in such a comparison because of the change that has come to the point of view of so many workers on account of later knowledge of the physical properties of the gases concerned in the gas-engine cycle. Mr. Clerk's point of view has also changed materially. The author remarks on p. 200:—

"Some things, however, have been definitely settled. Holborn and Austin's investigations have placed it beyond doubt that the specific heat of steam and carbonic acid increases considerably with increase of temperature, and that a small increase occurs with oxygen and nitrogen. Nernst's investigations have proved that the dissociation of steam and carbonic acid at about 2000° C. is unexpectedly small."

When the 1896 edition was published, and until a much later date, Mr. Dugald Clerk was disinclined to accept the contention of the French physicists that specific heat increased with temperature, and the thermodynamic part of that volume, which is, we notice, reproduced with but little change in the first 118 pages of the present one, was based on the constancy of specific heat. After reproducing this earlier work, Mr. Dugald Clerk now adds:—

"Throughout the present chapter the working fluid has been assumed to be dry air obeying perfectly the laws of Charles and Boyle; its specific heat has also been assumed to be constant throughout the temperature range. . . . It is now known that the specific heat of air is not quite constant between 0° and 1400° C. . . . The mean Kp between 100° C. and 1400° C. is about 8 per cent. higher than that between 100° and 200° C. . . . But it must be remembered that the efficiencies and mean pressures determined by these calculations for ideal air are not the efficiencies and mean pressures which would be proper to the actual working fluid. . . . Meantime, however, it may be taken that the reasoning and conclusions reached in this chapter are valuable when properly used."

From p. 119 onwards the author takes into account the variability of specific heat with temperature. Indeed, in virtue of its importance, the greater part of the book is devoted to the consideration of this matter and of the associated problems.

Practically all recent work is described at more or less length, and particular stress is laid on the important work carried out on gaseous explosions at the Royal College of Science, on the initiation of Prof. Perry. Mr. Dugald Clerk is able to reproduce a great deal of this experimental work which had not previously been published, and he analyses the results obtained with great skill and infinite patience. It seems a pity that the record of these experiments has not previously been published, and we can only surmise that their importance was not realised adequately, perhaps because the experimenters, Messrs. Bairstow and Alexander, did not bring out their points with the emphasis at Mr. Dugald Clerk's command. How far the accuracy of these experimenters will stand the test of time remains to be seen; the virtue that led Mr. Dugald Clerk to refer to them at such length is that they are the only experiments so far known from which can be obtained a series of cooling curves under various conditions of pressure and temperature. We anticipate that practical results of real use will be obtained from this work.

At the end of the volume the author reproduces the very valuable 1908 report of the Gaseous Explosions Committee of the British Association. It includes a description of Mr. Dugald Clerk's "zig-zag" experiments. It also criticises them, and gives reason for thinking that they may contain an error of as much as 10 per cent. The committee remarks, "If there be systematic error in Mr. Clerk's work it seems most likely that it lies in the estimate of heat loss," and proceeds to indicate a way in which this error can be corrected. It is very curious to read this report at the end of Mr. Dugald Clerk's book, when, on turning to his own account of these very experiments, he omits to discuss any correction of the kind. We think that it would have been better if some notice had been taken of the committee's remarks, although it may well be that to have done so would have led to such a mass of extra work that any author might shrink from it.

We are so grateful to Mr. Dugald Clerk for this interesting volume that we do not wish to press too hard the main criticism to which it is liable, viz. that it is insufficiently edited, that a tight enough grip is not held upon the subject, and that the style is not such as to make it easily readable.

THE DIAMONDS OF SOUTH AFRICA.

Die diamantführenden Gesteine Südafrikas, ihr Abbau und ihre Aufbereitung. By Dr. Ing. Percy A. Wagner. Pp. xviii+207. (Berlin: Gebrüder Borntraeger, 1909.) Price 7 marks.

AMONG the numerous works that have appeared on the subject of South African diamonds, the book before us is worthy of a very high place. The author has examined the diamond-bearing rocks and their relations during a visit to South Africa, and has studied the materials brought home in the laboratories of Prof. Rosenbusch in Heidelberg, and under Prof. R. Beck at Freiberg, to the latter of whom the work is dedicated.

The record of previous literature at the beginning is very full and complete, comprising the titles of 138 memoirs and books, besides general references to periodical publications. The distribution and character of the various "pipes" are clearly described, and the series of comparative ground-plans drawn to scale on p. 7 is very striking and instructive. The second division of the book contains an admirable account of the various minerals found in the pipes, of which minerals no fewer than about thirty species are described. In his chapter on the petrography of the country, the author adopts the views of Carvill Lewis and Bonney concerning the important part played by the rock to which the first-named author gave the name of "Kimberlite"; but besides the form of the rock first described from the Kimberley district, Dr. Wagner indicates the existence of a variety much richer in mica (biotite), which occurs in dykes in Orangia and northern Cape Colony. These rocks have been carefully studied by the author, who gives chemical analyses of them and the results of investigations under the microscope, illustrated by two plates containing photographs of rock-sections.

Since the discovery of diamonds enclosed in masses of eclogite (the "griquaite" of Beck) in the pipes of South Africa—a discovery announced in this country by Sir William Crookes and Prof. Bonney in 1907—special interest attaches to the various fragmentary rock-masses which occur so frequently in the "blue and yellow grounds" of the South African mines. The author devotes especial attention to the characters of this diamond-bearing eclogite, and cites the case of a similar rock having been found in the Bingera diamond field of New South Wales, as related by Mr. G. W. Card. It is interesting to notice that not only diamond but crystalline plates of graphite have been found by Harger and by Beck, enclosed in the eclogite masses. Various other rock fragments and mineral aggregates occurring with the eclogite masses are described in detail. The evidence of the existence of diamond enclosed in olivine, and of microscopic diamonds distributed through kimberlite, is also discussed, and the bearing of all these and other facts on the vexed question of the origin of the diamond is considered. The whole of the observations bearing on the subject appear to us to be stated very clearly and impartially.

We naturally look in this work for some account of the new diamond-fields of German South-west Africa, but at present the information upon the subject appears to be somewhat meagre. According to the only scientific account of the district which has as yet appeared, the diamonds occur in an undisturbed formation of Cretaceous Sandstone. This sandstone, according to Merensky, however, consists in great parts of grains of chalcedony and agate, derived from an amygdaloidal diabase, and it is this rock which is regarded by him as the original source of the diamonds. In 1908 this diamond-field had yielded a great number of small diamonds (usually four or five to the carat) of the aggregate weight of 39,762 carats and of a value of 550,000*l*.

The later chapters of the book deal with the methods of mining the "blue ground," and the different kinds of treatment to which it is subjected in order to extract the diamonds. A number of photographs of the various workings, and of the machinery employed, adds to the interest of these chapters, the information in which has been apparently obtained from trustworthy sources. The work closes with some interesting statistics showing the weight and value of diamonds yielded by each of the mining districts, and the average value per carat in each case. From 1898 to 1908 nearly thirty-one millions of carats were obtained in South Africa.

A LOST OPPORTUNITY.

The Stone Ages in North Britain and Ireland. By the Rev. Frederick Smith. With an introduction by Prof. Augustus H. Keane. Pp. xxiv+377; illustrated. (London: Blackie and Son, Ltd.) Price 6*s*. net.

THE problem of the Stone ages is one that is full of complications. The greater part of it yet remains unsolved, for the sum of our actual knowledge of the conditions of Palæolithic man is as nothing in comparison with our ignorance. By small degrees advances are made. It is found, for example, that in other continents the remains of analogous culture stages bear that striking resemblance to those of our own that is one of the most surprising features of the study of prehistoric man in all periods. But such additions to knowledge, interesting as they are, help but little to enable us to picture the lives of the men whom they concern. The advance must of necessity be slow, for it is given to few to be able to read in nature's writing the very incomplete record of early man. While empiricism may make a lucky shot now and then, it can be only to the trained and reflective searcher that we must look for any effectual progress. Of such trained and industrious men there is no lack, and their accumulated experience, sifted by a master, might even now be brought into line for the less instructed public. Meanwhile, we have enthusiasts, like the Rev. Frederick Smith, who spend years in gathering specimens and deducing theories from them, and present us with ample volumes, like the present one, well printed and fully illustrated, and with this for the moment we must be content.

Mr. Smith is an amateur in all senses of the word.

His love for every stone he has found appears throughout the whole book, and his grief at the loss of one specimen, of which he has only kept a drawing, is almost pathetic. That he is an amateur in the other sense is clearly shown by his method of presenting his case. A careful statement of the evidence which leads him to attribute this or that specimen to the Palæolithic or any age is hardly to be found, while his attitude is one of pure dogmatism with regard to the artificial character of the stones he is principally dealing with. It is manifestly unsafe to judge of such a point as the latter from a drawing alone, and that is all the reviewer has in the present case. But it is not unjust to assume that in Mr. Smith's own drawings of the stones he is dealing with, all the features that lead him to think them to be "artefacts" are shown at their best. Yet to the unprejudiced eye, familiar with man's handiwork in stone under primitive conditions, whether prehistoric or modern, there are very few in Mr. Smith's book that could safely be pronounced "artefacts."

This may appear to be a hard saying, and in a limited degree it is so, for, in default of some evidence, it is hard to think that the majority of the stones represented in Mr. Smith's figures show any signs of human handiwork. Nevertheless, it is quite conceivable that they may be the best that Scottish Palæolithic man could produce. But what is wanted is something approaching proof of human intention in the fashioning of them. Mr. Smith, in short, has mistaken a much-loved hypothesis for fact. As hypothesis, no one would have found fault with his volume. He has spent much time and many words, moreover, in demolishing phantoms; for instance, he is apologetic that his "implements" of basalt and similar rocks do not show the familiar "bulb of percussion," so common in flint tools, and yet he surely must know that the fracture of flint differs essentially from that of basalt or granite; he adduces (p. 14), as proof of the Palæolithic age of the stones, the fact that he never encountered a polished weapon, as if all tools or weapons of the later ages were polished; most assuredly the majority are chipped only. He refers to glacial striæ in support of the same contention, and for this we would commend to him the vast series of Neolithic scrapers with glacial markings that have been collected by Dr. Allen Sturge. Two pages of text and three figures are devoted to a single chipped flint, described (and doubtless rightly) as accidental by "a Cambridge expert." Here a claim is made that the facets of the surface are made to fit the ball of the thumb. As if the human hand had no power of adaptability! It is very likely that this and other flaked flints, whether the flaking be natural or artificial, will be found to fit the ball of the thumb, but the virtue lies in the thumb, not in the flint.

One other instance of Mr. Smith's arguments is worth quoting. He was distressed that the flaking on one of his flints had been set down as due to "thermal" causes. This criticism he meets by the statement that he had watched some of his flints pass through all the rigours of Scottish winters for no less a period than twenty long years, and that they showed no signs of thermal flaking at the end of it. Arguments of this kind can only convince the converted, and even the support of Prof. Keane, enthusiastic as he is, will hardly suffice to carry conviction to the unbiassed. The chapter on Ireland is of a piece with the rest. The author's naïve surprise at finding in Ireland precisely the same forms he had been finding in Scotland recalls to one's memory the letter from Egypt of the late Mr. Auberon Herbert, who found there the very same broken edges to flint flakes that he had seen in England, though it must be confessed that Mr. Smith does not go to quite the same lengths as Mr. Herbert.

A book of this kind makes one sad. Working on a stable foundation, Mr. Smith's pertinacity and enthusiasm might have enabled him to add his mite to the sum of our knowledge of early man. He has chosen, on the other hand, to follow a will o' the wisp.

CHEMICAL TECHNOLOGY.

(1) *L'Industria delle Materie Grasse.* Vol. i. I Grassi e le Cere. By Dr. S. Facchini. Pp. xxiii+651. (Milan: Ulrico Hoepli, 1909.) Price 6.50 lire.

(2) *Gomme, Resine, Gomme-resine e Balsami.* By Dr. Luigi Settimj. Pp. xvi+373. (Milan: Ulrico Hoepli, 1909.) Price 4.50 lire.

(3) *Analisi Chimiche per gli Ingegneri.* By Dr. Luigi Medri. Pp. xiv+313. (Milan: Ulrico Hoepli, 1909.) Price 3.50 lire.

(4) *Die Chemische Industrie.* By Gustav Müller unter mitwirkung von Dr. Fritz Bennigson. Pp. viii+488. (Leipzig: B. G. Teubner, 1909.) Price 11.20 marks.

(5) *Chemical Industry on the Continent: a Report to the Electors of the Gartside Scholarship.* By Harold Baron. Pp. xi+71. (Manchester: University Press, 1909.) Price 1s. net.

(6) *Laboratory Guide of Industrial Chemistry.* By Dr. Allen Rogers. Pp. ix+158. (London: Constable and Co., Ltd., 1908.) Price 6s. net.

(1, 2 and 3) THESE three volumes belong to the well-known and excellent "Manuali Hoepli." Dr. Facchini's treatise is the first volume of a series which, when completed, will cover the whole ground of the industry of fats, oils and soaps. It deals with the general chemistry of the fats and waxes, and the methods used in their analysis. It is a concise but fairly complete summary of the information included in the larger treatises on the subject, and should prove a useful book of reference in cases where the larger works are not available. The same remarks apply to the treatise on gums and resins by Dr. Settimj, which necessarily is in the main but a well-arranged and useful abstract of Tschirch's standard handbook.

Dr. Medri's little book on analysis is a compilation designed specially for the use of engineers rather than chemists. It summarises the methods of analysis of air, water, cement materials, combustibles—solid, liquid and gaseous—and of several of the principal metals and alloys in general use. There is also a short chapter on explosives.

(4) Councillor Gustav Müller's essay on chemical industry contains a wealth of information hitherto scattered in official publications and technical journals, and only to be gleaned with difficulty. There is little doubt that it will become an indispensable book of reference to the chemical merchant and manufacturer, as well as a guide to the works manager, on all economical and statistical questions concerning his industry. The early chapter on general economic development contains a brief history of the growth of chemical industry in different countries, with full statistics for all the different branches dealt with. Valuable information is collected with regard to patents and trade marks, and the existing "trusts" or "Kartels." A chapter covering eighty pages, on the legal control of the industry, includes a discussion of patent laws, factory acts, workmen's insurance and health regulations, and includes details of the tariff rates for Germany and of trading treaties with other countries. In the second part of the work, a chapter is devoted to each individual branch of chemical industry, and here complete statistics of imports and exports for several years past are collected for each substance considered. The whole work is excellently arranged, and cannot but prove of the very highest utility.

(5) Mr. Harold Baron's report is the outcome of a tour undertaken in 1905 as Gartside scholar in the University of Manchester. Under the tenure of these scholarships, each scholar has to select some industry or part of an industry for examination, and investigate this comparatively in the United Kingdom and abroad. The present report is an account of a visit to a large number of chemical and textile works in Belgium, northern France, and Germany, with comments on their character and organisation. The report makes interesting reading, and contains a good deal of information likely to prove instructive to those not well acquainted with Continental chemical works and their methods. The description given of the wonderful works of the Bayer Company at Elberfeld and Leverkusen deserves to be widely read. At Leverkusen the works are equipped with a water supply capable of producing thirteen and a quarter million gallons per day, the daily consumption of Cologne, a town with 400,000 inhabitants, being only thirteen million gallons daily. Some idea of the vastness of the colour works may be derived from the fact that the azo-colour department alone necessitates the use of 78,000 tons of ice per annum for cooling purposes. Mr. Baron's report is, on the whole, a just and accurate statement, but a few errors occur which need correction. For example, some of the statements with regard to the processes of manufacturing artificial silk need revision. Such errors were, perhaps, to be expected in a report prepared under the conditions of the present and dealing with a very wide field.

(6) Dr. Rogers's book and system we conceive to be based on entirely wrong principles. His scheme of training in industrial chemistry adopted at the Platt Institute, Brooklyn, consists in passing the students (the nature of whose chemical knowledge is rather uncertain) through a course of preparations and exercises under works-conditions in miniature. No attention is paid, apparently, to fundamental principles and process control. In less than 140 pages an enormous number of cookery-book recipes are given for the preparation of inorganic and organic compounds, pigments and lakes, driers, varnishes, paints and stains, soap and allied products, leather, wood pulp, and paper. The preparations are carried out with small works-plant, of which several illustrations are given in the book. We doubt the value of such a course in the education of a works-chemist, and consider that it would probably be to the detriment of the interests of his subsequent employers as tending to develop a blind and thoughtless empiricism. One of the most important factors in the success of a chemical works is a proper system of control, on scientific principles, of all stages of manufacture. We consider that it would be far better to work out a few—very few—manufacturing processes in detail, carefully studying by a proper system of tests the effects of varying the conditions, than to acquire a smattering of a large number of indiscriminately chosen works-operations. It is only by means of careful scientific control that chemical works in this country can hope to compete with foreign competition. To teach industrial chemistry as a series of cookery operations, involving the use of certain stock utensils, is likely to prove fatal in all cases, except in countries such as the United States, where high tariffs make economy of production a secondary consideration.

W. A. D.

HANDBOOKS ON ANIMAL STUDY.

(1) *Zoologia.* By Angel Gallardo. Pp. 474. (Buenos Aires: Angel Estrada Cia., 1909.) Price 6 dollars.

(2) *Einführung in die Biologie.* By Prof. Karl Kraepelin. Pp. viii+322. (Leipzig and Berlin: B. G. Teubner, 1909.) Price 4 marks.

(3) *The Freshwater Aquarium and its Inhabitants.* By Otto Eggeling and Frederick Ehrenberg. Pp. vii+352. (New York: Henry Holt and Co.; London: G. Bell and Sons.) Price 8s. net.

(4) *Bilder aus dem Ameisenleben.* By H. Viehmeyer. Pp. viii+159. (Leipzig: Quelle und Meyer, n.d.) Price 1.80 marks.

(5) *Die Schwarotzer der Menschen und Tiere.* By Dr. O. von Linstow. Pp. viii+144. (Leipzig: Quelle und Meyer, n.d.) Price 1.80 marks.

(1) IT seems almost axiomatic that if a text-book of zoology begins by dealing with the obscure details and overwhelming nomenclature of cytology, it is a bad book. Bad because organisms are not aggregates of cells, and because such a method is essentially an inverted one in relation to the grasp of the beginner. In this text-book, written for the School of Pharmacy at Buenos Aires, the inversion appears complete. The end of the book is an introduction showing how zoology has been pursued in the republic, whilst the beginning is occupied by Karyokinesis, modes of segmentation, and other difficult subjects. After general histology, we have evolution and transformation-theories treated in that diagrammatic and

dogmatic way that is so destructive of their interest and advancement. The classification of animals adopted, Unicellularia, Radiata, Bilateralia, is almost as antique as that of the animal and vegetative functions maintained in the earlier part of this book. The "worms" are reduced to a type characterised by a trochosphere-larva and nephridia, whilst, for the benefit of medical students, only parasitic forms are described. The book is, in fact, a compilation of the "cram" order, and is devoted mainly to the structure and life-history of parasites. In no single instance is the scale of a figure given.

(2) In spite of the very large output of books on biology, there is still no modern work in which the factors of the life of plants are correlated with those of animal life in a broad and intimate manner. This text-book is, perhaps, as near an approach to such a treatment as the limits of a cheap school-book allow, and in the second edition just issued the breadth of treatment has been increased. The contents are divided into three parts. First come the relations of organisms to environment; then follows an account of structure and functions; lastly, a brief chapter on psychology and anthropology. Between the last two parts is a short, clear account of evidence for the theory of descent. Of these three sections, the first is undoubtedly the most novel for a work of this kind. It is very doubtful whether the author has not attempted to compress far too much information into these pages, and certainly the attempt to teach the subject from such a book as this without simplifying its contents would be disastrous. The work itself appears to be a well-illustrated summary of facts, but is as hard to assimilate as a concentrated foodstuff. The teacher must supply the zymogen.

(3) In this American book the experience of the professional "aquarist" and importer has been combined with that of the practised amateur. The result is a volume full of interesting matter and of practical suggestion to naturalists and teachers. The introduction of many beautifully coloured fish from Texas, Florida, India, and other countries into the northern States enables a very great choice of interesting subjects to be drawn upon. The climbing perch, the "shooter" that brings its prey down by spitting, and the lovely Paradise fish Macropodes, the nests of which are readily constructed in captivity, are some of the more striking oriental fish introduced by one of the authors. The Reptilia and Amphibia are also fully considered, and the book concludes with most useful advice on the choice of natural and artificial foods. In these days of experimental stations and school laboratories, such a practical guide as this should be very welcome. The illustrations are excellent, and the only fault we have to find with the work is its weight, which not only splits the binding, but tires the hand.

(4) The value of this little book lies in the fact that its descriptions of the occurrence and habits of ants are largely written down from the author's observation. The sketches are thrown into a conversational form so as to appeal to children. The various beetles found in ants' nests are fully considered and figured, and the author is evidently acquainted with the literature of the subject. We can heartily recommend this little book as a record of long and patient observation, and as a very useful *résumé* of the most distinctive and interesting features in the life of these highly organised animals.

(5) Dr. von Linstow's popular account of human and animal parasites ends badly from the beginning. On the cover of the book there is a gruesome picture of infected pond-life, and a tragedy occurs on almost every page. The contents describe some appalling cases of the course of parasitical diseases, and whilst we fully acknowledge the abundant knowledge and clear exposition that has gone to its making, we can hardly believe that such a treatise is appropriate to a series suitable for children and people generally. Pan certainly has a terrifying aspect when seen thus, and it would have relieved the depression if the available prophylactic and remedial measures could, as far as possible, have been described.

ELEMENTARY PHYSICS.

(1) *An Introduction to Physical Science.* By Dr. F. H. Getman. Pp. ix+257. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 6*s*. 6*d*. net.

(2) *An Elementary Course in Practical Science.* Part iii. By C. Foxcroft and S. J. Bunting. Pp. 64. (London: G. Philip and Son, Ltd., n.d.) Price 6*d*. net.

(1) THE book by Dr. Getman is intended for those students who, owing to little knowledge of physics, find it difficult to understand lectures on general chemistry. It deals in a brief manner with all the usual sections of physics, with the exception of sound. It is in many respects an admirable book. The chief laws and principles are in most cases very clearly expressed. As an example of this, attention may be directed to the concise and unambiguous treatment of the distinction between "mass" and "weight." The diagrams are good, and logical order is preserved. There is no doubt that a student thoroughly conversant with the contents would have little difficulty with his chemistry from a physical point of view. On the other hand, we think that for several reasons the book itself presents difficulties. The definitions, particularly in the first chapter or two, are sometimes rather loose. Matter is apologetically defined as "that which occupies space," a statement which is worthless. Surely a better provisional definition is "matter is that which has weight," and then the extension of "weight" to "gravitational attraction" could follow at a later stage. Again, a solid is defined as "a body which at ordinary temperatures does not change its shape under slight changes of pressure." This is untrue. There is no distinction, except in degree, between solids and fluids in this respect. The terms "stress" and "strain" are insufficiently defined, being merely given as alternatives for force and distortion respectively.

We feel, too, that the cutting out of detail, which the author admits in the preface, has been carried too far. The descriptions of experiments are thus in many cases vague, and in a few instances actually misleading. For example, in the determination of the latent heat of water, we are told that "a *weighed* quantity of dry ice is now added to the water." Such procedure would, needless to say, be fatal to the accuracy of the measurement. It may be mentioned also that in describing the measurement of an electric current with a tangent galvanometer, the author neither mentions the very necessary adjustment of the coils parallel to the magnetic meridian, nor does he show the bearing of the strength of the earth's field on the absolute value of the current. Altogether, from the point of view of practical physics the book leaves much to be desired. Indeed, the author goes so far as to suggest that the practical part may be entirely omitted.

A further point should be mentioned. Although there is an extensive set of very suitable numerical examples given, practically no specimen examples are solved. It is very doubtful whether an average student could, unaided, successfully attack them. When it is remembered that it is mainly by the frequent use of numerical and practical exercises that the principles of physics are most easily and thoroughly instilled into the mind, it will be recognised how serious are the above omissions.

(2) This book is the third of a series on simple physical measurements, &c., and is drawn up on the same general method as the previous ones, viz. to leave as much as possible to the student's initiative and common sense. The exercises, although still very simple, are of a somewhat higher standard, and include further measurements in the subjects previously dealt with, and a few experiments in elementary chemistry. This method of teaching is somewhat novel, and probably the correct one. Where time is a consideration, however, it may not be practicable.

OUR BOOK SHELF.

A Brief Course in the Calculus. By W. Cain. Pp. x+280. (London: Blackie and Son, Ltd., 1909.) Price 6*s.* net.

THIS is a new publication of an American book, and deals with both the differential and the integral calculus. Following the more recent English treatises on the same subject, the author begins with an introduction on graphs, in which he confines himself to the simplest cases of the usual functions. The value of such an introduction would, perhaps, be enhanced if the reader were shown how to draw quickly even rough graphs of such functions as x^2+x+1, $(x^2-1)/(x+2)$, &c., indeed, of *rational* functions. The point of view of the author may be obtained from his own words (p. 27):—"The above examples represent loci whose asymptotes are easily determined by inspection. For other cases, particularly where the asymptotes are inclined to the axes, advanced treatises on the Calculus must be consulted."

Derivatives are introduced through the notion of a limit. After the derivative of x^n has been established (without using the binomial theorem), discussion of the slope of a curve and of rates follows. If the graphical part had been developed more fully, the latter notions might have taken precedence of and led up to derivatives. Such a mode of treatment would perhaps have given a greater air of reality to the derivative in the case of readers who have time for only a short course in the calculus, and whose power of mathematical perception has not been highly trained. The author, however, has good authority for the order he adopts, and he keeps well in view the needs of those who want a careful study of the subject as well as those who are likely to apply their knowledge to geometry, mechanics, and physics. He has dealt fully and carefully with the outstanding parts of the subject, and works out many examples; it is doubtless in consistency with his whole aim that he does not give a very large number of examples to be worked out by the reader, in this respect differing from most authors of mathematical books. To teachers and students who prefer a smaller number of examples, and need a work in which the method and province of the calculus are presented by a careful writer, the book can be recommended as likely to be a useful introduction to the subject. P. P.

The Life of a Fossil Hunter. By Charles H. Sternberg. Pp. xiv+286; with 46 plate illustrations. (New York: Henry Holt and Co.; London: George Bell and Sons, 1909.)

THIS is a simple and readable story of the experiences of a fossil hunter in the wild west of North America. As Prof. Osborn remarks in his brief introduction, "the revivification of the past" by the discovery of fossils "is attended with as great fascination as the quest of live game." No one has met with greater success in such pursuits than Mr. Charles Sternberg, the well-known collector of extinct vertebrates, who now recounts some of his experiences during the past forty years; and he has produced a small book which will be read with pleasure by all who are acquainted with the fine specimens which he has obtained for several of the great museums. The well-printed text is illustrated by a large number of inset plates representing scenery, fossils discovered by the author, portraits, and several excellent restorations of extinct reptiles from the American Museum of Natural History, New York.

In the early days of his explorations, Mr. Sternberg was exposed to danger from the Indians whose country he invaded, and there are several interesting stories of his adventures both with them and the settlers. In later years, and even under the most improved conditions, the hardships have still remained considerable, for the most fruitful regions for fossils are always those most destitute of vegetation, where the whole face of the rock is exposed and can be closely scanned. The suffocating nature of the dust and the alkaline or saline condition of most of the available water supply always prove troublesome, and the laborious excavation of fossils in such circumstances, beneath a burning sun, involves real enthusiasm for the work. Mr. Sternberg, after long experience, has brought his methods to perfection, and he gives interesting illustrations of the manner in which the most fragile skeletons can be disinterred from the rock without injury. He began by collecting fossil leaves from the Dakota Cretaceous sandstone. Afterwards, with the encouragement of the late Prof. E. D. Cope, he obtained mosasaurs and fishes from the chalk of Kansas. Then he made several successful trips to the Permian of Texas, in which he discovered numerous new reptiles and labyrinthodonts. Finally, he has worked the Laramie Cretaceous formations of Wyoming, and the Loup Fork Tertiary formation of Kansas. Besides enriching the museums of America, Mr. Sternberg has contributed many important specimens to those of Europe, especially to the Palæontological Museum of Munich and the British Museum. The latter is indebted to him for a skull of Triceratops, a skull and a skeleton of Pteranodon, several Mosasaurians, some fine chalk fishes, and a mandible of a primitive Mastodont (*Tetrabelodon dinotherioides*). He is still in the field, now accompanied by his sons, whom he has trained to follow him.

A. S. W.

The Book of Nature-Study. Edited by Prof. J. B. Farmer, F.R.S. Vol. IV. Pp. viii+210. (London: The Caxton Publishing Company, n.d.) Price 7*s.* 6*d.* net.

The fourth volume of this attractive publication is devoted entirely to botany. The descriptions by Dr. W. H. Lang of some common plants flowering in the spring and summer appeared in the previous volume; the continuation refers to plants that flower later in the year and others of special morphological interest, such as the honeysuckle, dodder, sundew, and types of trees. The Scots pine serves as a representative gymnosperm, while a brief account of pollination and seed dispersal closes Dr. Lang's contributions. His precise and orderly descriptions provide excellent models for a student to emulate.

To Dr. W. Cavers has been entrusted the somewhat difficult task of preparing an interesting account of the cryptogams, and in this he is very successful. He adopts a less formal method of description than Dr. Lang, and by confining himself merely to the more important characters, he is enabled to direct attention to a large number of species. Most of the indigenous ferns and fern allies are noted, and the more striking mosses and liverworts. Lichens form the subject of a separate chapter, but algæ are omitted, and only outlines of the fungal groups are indicated. This section and the former one are confined to morphology as distinct from ecology, which provides the bulk of the third section contributed by Miss C. L. Laurie, although the heading, "Woodland Vegetation," appears in the contents. The ecological section suffers from a want of definition of the main objective. The descriptions of the moors, commons, and heaths are quite definite, perhaps somewhat brief, but the interpolation of parasites and saprophytes in the middle of plant associations presents an unnecessary confusion of ideas. The chapter on woodland vegetation is very instructive, albeit the paragraphs are somewhat disjointed, and no definite tree formations are fully described as such.

The illustrations are numerous and excellent; the coloured plates of single plants, notably of the honeysuckle, are admirable specimens of reproduction, and the plain photographs are practically as effective for their purpose. Two photographs of lichens, the woodland photographs by Miss Tidman, and the illustrations of the mistletoe and goat-willow are perhaps the choicest: but it is somewhat invidious to draw distinctions, as the contributors include Dr. O. V. Darbishire, Mr. H. Irving, and Mr. Chalkley Gould.

Éléments de la Théorie des Probabilités. By Émile Borel. Pp. viii+190. (Paris: A. Hermann et Fils, 1909.) Price 6 francs.

Like all Prof. Borel's works, this is a very pleasant book to read. It is in three parts, dealing respectively with discontinuous problems, continuous problems, and those in which *a priori* probabilities are involved. The second part contains, among other things, a useful sketch of Gauss's theory of errors; and the third gives some applications to statistics and biology. Some of the problems are quite amusing; for instance, "Pierre plays écarté with a stranger, who turns up a king the first time he deals. What is the probability of his being a professional cardsharper?"

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Magnetic Storms.

The last English mail which arrived in India brought the newspapers containing the account of the magnetic storm of September 25, and in the *Times* Sir Oliver Lodge's opinion on the cause of such storms is given. It appears, however, that three of the statements contained in that account are not entirely supported by experimental and observational evidence, and would not be subscribed to by those who have recently been working at the problems of atmospheric electricity.

(1) Sir Oliver Lodge remarks:—"Some of them" (electrons from the sun), "especially at the times of the equinox, may come down near the equator. Those which journey to the Poles are accompanied by an opposite current in the crust of the earth from the equator to the Poles, and this it is which disturbs the telegraphs, being picked up or tapped by them *en route.*" Now if a large quantity of negative electricity were suddenly added to the upper atmosphere, and this induced a corresponding charge of positive electricity on the earth's surface, it would of necessity disturb the existing potential gradient in the atmosphere.

The extent of the disturbance can be roughly calculated by treating the earth's surface as an infinite plane. Suppose that the electrons moving in the upper atmosphere and adjacent space are uniformly distributed; their electrostatic and horizontal magnetic effect at the earth's surface will then be the same as if they were confined to a plane parallel to the surface of the earth. Let the surface density on the plane be σ and the velocity of the ions in the plane v; H will then be changed by $2\pi\sigma v$. Now Dr. Chree states (Nature, September 30) that during the magnetic storm H varied by more than 740 γ; for convenience let us take the change in H to be only 700 γ, *i.e.* 0·007 electromagnetic unit. Hence $2\pi\sigma v=0{\cdot}007$, or $\sigma=0{\cdot}007/2\pi v$. If σ is measured in electrostatic units this becomes $0{\cdot}007\mathrm{V}/2\pi v$, where V is the velocity of light. The electrostatic field between the charged plane and the earth would be $4\pi\sigma$, *i.e.* $4\pi\times 0{\cdot}007\mathrm{V}/2\pi v$ or $0{\cdot}014\mathrm{V}/v$. Expressing this field in volts per metre, we have $0{\cdot}014\times 300\times 100\mathrm{V}/v$, *i.e.* $420\mathrm{V}/v$. Now v cannot be greater than V, hence the smallest value of the field would be 420 volts per metre. This value is more than four times greater than the normal value of the potential gradient in the atmosphere, and it is of the opposite sign. This calculation is not supposed to be quantitatively accurate, but it gives in a simple way the order of magnitude of the effect. Hence it is seen that the large electrical charges which would be required to produce the magnetic effects observed, even if they moved with the velocity of light, would be easily recognised by their effect on the potential gradient. For many years instruments have been in use in different parts of the earth giving continuous records of the potential gradient in the atmosphere, but, so far as I am aware, no effect of a magnetic storm has ever been reported. Such an instrument is in use in Simla. On the day of the storm the weather here was perfect, so that if any effect of the kind had taken place it would have been clearly seen; but, as a matter of fact, there is absolutely nothing on the record to distinguish the period of the magnetic storm from the periods on either side of it: the potential gradient was entirely normal throughout September 25 and 26. It would therefore appear that the great earth currents associated with magnetic storms are not, as Sir Oliver Lodge suggests, due to induced charges.

(2) Sir Oliver Lodge further says, regarding the electrons:—"Those which enter the atmosphere elsewhere act as nuclei for condensation of moisture, and by screening the sun's rays are probably responsible for some of the dull and overcast weather." This statement is apparently based on a misconception of Mr. C. T. R. Wilson's experiments on the condensation of water vapour on ions, for these experiments do not afford any real support to

such an idea. Mr. Wilson's results showed that ions may become the nuclei for condensation, but only when the air is both dust-free and supersaturated four-fold. An infinity of ions in dusty air, or in air supersaturated three-fold, would not cause clouds, and as neither dust-free nor supersaturated air have ever yet been met with in the atmosphere, it is difficult to see how electrons from the sun could produce cloudy weather.

(3) These considerations apply, but with still greater force, to Sir Oliver Lodge's next sentence:—"Local thunderstorms are also a not unlikely result." This is not the place to go into the controversy over the Wilson-Gerdien theory of thunderstorms, but it ought to be pointed out that very strong reasons have been put forward for doubting that the condensation of water on ions plays any part in thunderstorms. GEORGE C. SIMPSON.

Meteorological Office, Simla, October 21.

The Identity of Certain Large Birds on Egyptian Vases.

IN looking to-day for an archæological reference in my friend M. Jean Capart's valuable volume on "Primitive Art in Egypt" (English edition), I noted that he has determined certain birds, delineated on a series of decorated vases, as ostriches. The vases I refer to are to be found on p. 116, Fig. 88; p. 118, Fig. 91; p. 119, Fig. 92; p. 120, Fig. 93; p. 121, Fig. 94; and p. 123, Fig. 96. I venture to suggest that the birds intended to be represented are not ostriches, but flamingos. The inbent beak, the dorsal body-contour, the horizontal ventral region, and the long, lanky legs, uncovered by feathers in the tibial region as in ostriches, all so characteristic of the flamingo, are delineated with great truthfulness on a large scale on the vase illustrated on p. 123, Fig. 96. The crosier-staff-like head is common to all the drawings I have indicated. Although the representation of the bird on p. 120, Fig. 93, is rather too small and ill-defined to base much upon, the curvature of the neck is yet more that of a ciconiiform than of a struthious bird. Indeed, on p. 119, Fig. 92, the group of birds at the right-hand corner of the vase is actually in proximity to water, which would hardly be the case if the artist intended it for one of ostriches; while on the vase illustrated on p. 121, Fig. 94, the four birds delineated have very characteristic horizontal flamingo tails, especially the individual on the extreme left of the row, in which it is spread. These attitudes are in striking contrast with those of certain other large birds included in the zoological group on the rocks of Upper Egypt, reproduced on p. 204, which must be admitted to represent ostriches, at the first glance, from the attitude of their legs in walking, their plumage contour, and their straight beaks.

The above suggestion I have made during the past two or three years to several Egyptologists, who have recognised its valency; but as I have seen nowhere this emendation, which I believe it to be, recorded, I think it may be of interest to give it publicity, inasmuch as the ethnographical deductions to be drawn from these rude pictures can be correct only if the artist's intention has been accurately interpreted. HENRY O. FORBES.

The Museums, Liverpool, October 31.

November Meteors.

THE absence of moonlight during the Leonid epoch of the present year will be favourable for observations of this historic shower. For determining on which of the three dates of November 14, 15, and 16 it may occur, calculations made by the writer point to the night of November 16 as that of the maximum, when, as was the case on the corresponding night of last year, the number of meteors radiating from the Sickle may be found by observers to be considerable. The following are details as to this and also other showers that become due during the remainder of the month of November:—

Leonid epoch, November 16, 8h. G.M.T. This shower is of the sixteenth order of magnitude, having its principal maximum on November 16, 15h.; other maxima take place on November 16, 10h. and 18h., and November 17, 21h.

Epoch November 21, 9h. 30m., shower of fourth order of magnitude. The principal maxima occur on November 19, 21h. 15m., and November 20, 18h. 30m. Two other maxima occur on November 20, 2h. 30m. and 5h. 30m.

Epoch November 21, 17h. This shower, which is of the fifteenth order of magnitude and immediately follows the former, has its maxima on November 21, 21h., and November 22, 11h. 30m.

Epoch November 26, 1h. 30m. This shower, of third order of magnitude, has two principal maxima, on November 26, 15h., and November 27, 2h. There is another maximum on November 27, 5h.

Epoch November 29, 20h. 30m., of third order of magnitude; has its principal maximum on November 29, 17h., with an earlier maximum on November 29, 3h. 30m.

Dublin, November 8. JOHN R. HENRY.

The Absence of a Lunar Atmosphere.

WITH reference to Mr. Alexander Johnson's letter on this interesting subject, I should like to point out that the theory of radiation pressure is not applicable to gases. Beyond a certain range of minuteness, the effect of radiation pressure on particles diminishes, and the size of a particle on which the repulsive force of light is at a maximum is vastly greater than molecular magnitudes. As this is very important, I quote certain numerical determinations given by Prof. Arrhenius ("Worlds in the Making," pp. 97, 98):—

(1) Diameter of a totally reflecting sphere which would be in equilibrium near the sun under the opposing forces of gravitation and radiation pressure = 0·0015 mm., the specific gravity of the sphere being the same as water.

(2) For radiation pressure to be effective, the diameter of the particle must exceed 0·3 of the wave-length of the incident radiation. If smaller than this, gravitation predominates.

(3) Radiation pressure is at a maximum when the diameter of the particle equals the wave-length of the incident light (*e.g.* 0·5 μ for the blue-green region about λ 5000 A.U.).

(4) In the case of sunlight, which is not homogeneous, Prof. Arrhenius gives 0·00016 mm. as the diameter of particles on which the effect is greatest.

As regards the absence of a lunar atmosphere, it seems that we must fall back on the kinetic theory of gases and attribute it to the gradual escape of the more swiftly moving molecules into the surrounding space.

CHARLES W. RAFFETY.

Wynnstay, Woodcote Valley Road, Purley, Surrey,
November 1.

Pitchblende as a Remedy.

As there is now no longer the least doubt as to important cures being effected by means of radium, the question arises whether crude pitchblende would not also have beneficial effect if applied in the case of minor chronic ailments. Perhaps one of the readers of NATURE will be able kindly to give some information on this subject. The very minute proportion of radium in pitchblende need be no real objection. If we substitute, in the case of pitchblende, grams for milligrams and days of application for so many minutes, a disparity of one million is soon made up, and there may be some action, although perhaps different from that of a pure radium salt. Moreover, we must expect a beneficial influence from minute quantities of radio-active substance if the assumption is to be finally proved that certain thermal waters owe much of their virtue to such traces. In addition to raw pitchblende, a possible utility of pure (yellow) uranium oxide might also be considered. H. WARTH.

SOUTH AFRICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE seventh annual meeting of the South African Association for the Advancement of Science opened at Bloemfontein on Monday, September 27, under the presidency of the Governor, Sir Hamilton Goold-Adams. The advantage of Bloemfontein for such a conference, in that it is in the centre of South Africa, was observable in the number of busy men who were able to run down from Johannesburg, Pretoria, and Kimberley for the occasion, to whom the usual two days and two nights' journey in the train necessary to travel from one centre to another would have been prohibitive. The meeting was the most successful so far held, from the fact that the Governor, the municipality, the Press, and the citizens generally, united in welcoming the delegates from the various centres, and in showing appreciation for the objects of the association.

In the opening address the president struck the dominant note of the meeting, namely, that science is not of purely academic interest, but that the results won by scientific men could be understood by the unlearned if they tried, and that the results could be applied to everyday life with material benefit. The text of the address was the "Application of Chemistry in Agriculture." The mining industry has a very important bearing on the prosperity of the country, "yet agriculture must be considered as the main and permanent foundation upon which the future progress of the nation must rest."

The acting mayor, Mr. A. E. Parfitt, in welcoming the delegates, said, "I daresay that from a sanitary point of view this town excels all others in South Africa," a wonderful statement in view of what the town was like only a few years ago. This fact was more fully brought out by Dr. Tomory, medical officer of health for the town, later on in his paper on "Recent Methods of Water Purification," in which he dealt with the merits of slow sand filtration and the American methods of rapid chemical treatment; the Bloemfontein system is a compromise between the two.

Prof. W. A. D. Rudge, of Grey College, Bloemfontein, president of the section of astronomy and mathematics, opened the sectional meetings at the Normal College buildings on September 28 with an address on the "Genesis of Matter." Mr. Hugh Gunn, Director of Education in the Orange Free State, president of the education section, took for the subject of his opening address "The Problem of Rural Education." He considered this to be the most exigent question of the moment. Farmers had done their best, but the badly provided farm schools, staffed with one teacher, whose emoluments were poor, and whose qualifications corresponded, were inadequate. Rural schools were regarded as being on the lowest rung of the educational ladder. He calculated that barely one-quarter of the area of South Africa was provided with school facilities, and that 80,000 children of school age were not attending school. Of this number he thought two-thirds lived in the rural districts. He wished to abolish single-teacher schools, and to replace them with three-teacher schools. This could be done by providing transport facilities. A beginning had been made in the Orange Free State with satisfactory results, and he hoped to see the system extended.

Dr. C. F. Juritz, of Cape Town, opened the section devoted to chemistry and geology with an address on "Agricultural Chemistry." The following are the more important papers read in the various sections. Unfortunately, the sections were reduced to three, and had subsequently to be divided to enable all the papers to be read, hence some confusion ensued in regard to placing the papers in their proper section.

Water vapour on Mars, J. de Fenton; notes on the geology of Natal, J. A. H. Armstrong; revised list of the mammals of South Africa, E. C. Chubb; puberty rites of the Basuto, and prehistoric African fauna and flora as evidenced by African philology, Rev. Father Norton; maize breeding, R. W. Thornton; cultivation of maize, J. Burtt-Davy; solar radiation, H. E. Wood; the great snowstorm of August, 1909, H. E. Wood; the Breede River irrigation works, T. E. Scaife; notes on the recent magnetic storm, G. W. Hopkinson; the flora of Portuguese East Africa, T. R. Sim; the vegetation of the southern Namib, Dr. R. Marloth; lime and milk, R. Pape; the composition of milk in Cape Colony, St. C. O. Sinclair; notes on the fauna and flora of Sarawak, J. Hewitt; mental healing, Right Rev. Bishop Chandler; the value of the practice and teaching of hygiene in schools, Dr. Targett-Adams; the salt pan of Haagenstad, G. W. Cook; the bearing of recent theories on the nature of the earth's interior on the question of deep mining, Prof. E. H. L. Schwarz; itacolumite from Swaziland, Prof. G. H. Stanley; observations on the vascular system of *Hemitelia Capensis*, H. G. Morris; notes on the anatomy of Widdringtonia and Callitris, W. T. Saxton; the principles of the naturalisation of forestry, C. Robertson; architecture, H. Baker; the relative growth of our white and black population, J. M. P. Muirhead; classics in our secondary schools, Dr. J. Brill; biography of Mohlomi, traveller, witch-doctor and chief, A. C. McGregor; the tercentenary of the telescope, H. B. Austin; the English language and literature in South Africa, Prof. Stanley Kidd; education in a Swiss canton, A. M. Robb; practical education, T. Lowden; agricultural training of natives, Hobart Houghton; weights and measures for South Africa, R. T. A. Innes.

Members of the association were taken round the new buildings of the Grey University College and the Grey School. The admirable building stone from the Bloemfontein commonage and the northern Free State allows the local architects to build elegant buildings; but this may become somewhat of a disadvantage, and leads often to cases where the effect of a window from the outside is considered more than its usefulness in the inside. A second excursion was to the military cantonments at Tempe, but the most instructive outing was to the dry farm at Groot Vlei, where lucerne, fescue, burnet, sainfoin, and other fodder plants, besides cereals, are grown without irrigation. A large area of the farm is planted with the Australian salt bush, which thrives admirably; the soil does not appear to be brak here, but, rather, is unproductive on account of its being clogged with fine silt.

Two popular lectures were given in the Town Hall, one on "Celestial Chemistry," by Dr. C. F. Juritz, and one on "Explosives," by Mr. W. Cullen, of the Modderfontein dynamite factory. At the close of the latter the British Association medal and cheque of 40*l*. were presented to Dr. Harry Bolus, the botanist.

At the annual general meeting the report of the council was presented, which showed a large decrease of membership owing to the prolonged depression in South Africa. To meet the decrease in income it was proposed to abolish one of the permanent offices, either the Johannesburg or the Cape Town one; it was also proposed to issue the Transactions in monthly parts. In view of the opening of the Union Parliament in Cape Town next year by His Royal Highness the Prince of Wales, it was proposed to hold the 1910 meeting in Cape Town at about the same date. His Excellency Sir Hamilton Goold-Adams was asked to offer the presidency of the association to His Royal Highness.

Mr. Lowden brought forward the subject of a prize scheme, which was discussed at some length both at Cape Town and at Johannesburg, and urged that something should be done to induce young students to take up science subjects. He suggested that if nothing else could be done, the association should offer at least a medal for the first two students matriculating in each science subject, and that if the funds of the association were not available, a subscription should be raised for the purpose. After some discussion the president stated that he would like to mark in some way his appreciation of the work of the association and the honour done him in electing him the president for the year, and he thought he could do this by offering to defray the cost of the die of a suitable medal for the purpose suggested by Mr. Lowden. On the proposal of Mr. Innes, seconded by Dr. Juritz, it was resolved to accept this offer with many thanks, and to name the awards the "Goold-Adams" medals.

The Bloemfontein Museum deserves an article to itself; the members of the association were shown over the collections, and from cupboard and cranny objects of the utmost value were unearthed, including meteorites, stone and iron ones, Karroo fossils, early printed books, engravings, manuscripts, Bushmen implements, and a complete quagga skin. The collections urgently need proper accommodation, and it is hoped that the visit of the association brought home to the authorities some realisation of what a valuable asset for the town they had in their museum.

Dr. R. T. A. Innes was elected honorary secretary for the Transvaal and Free State, and Dr. C. F. Juritz for Cape Colony and Rhodesia, Dr. R. T. Lehfeldt honorary treasurer.

At the close of the meeting forty-five members left for a train and wagon trip to Basutoland, the railway authorities having placed a special train at the disposal of the association.

AMERICAN CAVE VERTEBRATES.[1]

PROF. EIGENMANN has brought together in an attractive and copiously illustrated quarto volume the results of his investigations on the cave fauna of America, upon which he has been engaged for many years. He points out that each cave is a separate environmental unit requiring special consideration, but all share to a greater or less extent certain common features, viz. the reduction or total absence of light and the relative constancy of other physical conditions, such as temperature.

The blind cave vertebrates form a very mixed faunistic group, derived from a variety of epigean ancestors. It appears, however, that "a certain predisposition in habit and structure must be present to enable a species to dispense with light and to live in caves." No mammals appear to have become especially adapted for permanent cave life, though, of course, many spend a large part of their lives in such situations. They may be "twilight animals," but they still have normal eyes. The same is the case with birds, and there are also no cave reptiles, which is remarkable when we consider that many snakes and lizards are blind, and burrow underground.

It is amongst the amphibia and fishes that true cave vertebrates are to be found. Two of the North American salamanders, of the genus Spelerpes, which habitually live in caves, still possess what appear to be normal eyes, while two others, of the genera Typhlotriton and Typhlomolge, have their eyes quite degenerate, resembling in this respect the European Proteus. The Amblyopsidæ are the typical North American cave fishes. "All the members of this family, eight in number, have degenerate eyes; five have mere vestiges; six permanently live in caves; one is known only from a spring, and another from open streams." More remarkable is the fact that in Cuba two sightless fishes, Stygicola and Lucifuga, belonging to a marine family many of which are blind, have become adapted to the fresh waters of caves.

Space forbids us to follow the author in his detailed and interesting discussion of the origin of the cave fauna. We may note, however, that he seems inclined to regard blindness as an antecedent rather than as a consequence of cave life, for it is only animals which are already accustomed to find their food by the sense of touch or smell which could ever establish themselves in complete darkness. In Amblyopsis, and other blind fishes, great numbers of special tactile organs are developed, especially about the head, and these serve for ascertaining, by disturbances in the water, the whereabouts of prey.

In the case of the loss of colour, however, which is such a general character of animals living in perpetual darkness, it is different, and Prof. Eigenmann regards this character as due in the first place to the direct influence of the environment upon the individual. To quote his own words, "The bleached condition of animals living in the dark, an individual environmental adaptation, is transmissible, and finally becomes hereditarily fixed." This conclusion is based upon the fact that in Amblyopsis the bleaching takes place even when the young are reared in the light. "Natural selection cannot have affected the coloration of the cave forms, for it can be of no consequence whether a cave species is white or black. It could only affect the coloration indirectly in one of two ways: first, as a matter of economy, but since the *individual* is in part bleached by the direct effect of the darkness, there is no reason why natural selection should come into play at all in reducing the pigment as a matter of economy; second, Romanes has supposed that the colour disappeared through the selection of correlated structures, a supposition he found scarcely conceivable when the variety of animals showing the bleached condition was considered." It appears to us that these conclusions are of great interest and importance, and that Prof. Eigenmann has made out a strong case for the inheritance of acquired characters in this instance. In the case of Proteus it appears that the bleached condition has not yet become hereditarily established, for this animal becomes darker when exposed to the light. Possibly, after all, the inheritance or non-inheritance of acquired characters is largely a question of time, or, perhaps better, of the number of successive generations which have responded ontogenetically to the particular stimulus which evokes the character in question.

A great part of the volume is devoted to the consideration of the structural changes which accompany the degeneration of the eyes, and the author has given us a large amount of very valuable information on this difficult subject, including a detailed account of the development of the eye of Amblyopsis. From many points of view this interesting work will well repay a careful perusal.

ARTHUR DENDY.

THE PRESERVATION OF NATURAL MONUMENTS IN GERMANY.[1]

THE German Government has been, for the last two years, organising a national system for the preservation of the natural monuments of the country. During the last year the scheme has developed in comprehensiveness, and has produced gratifying results. There are now forty local committees, and at the end of last year the first Congress for *Naturdenkmalpflege* in Prussia was held at Berlin. A considerable number of valuable reports has been issued; the present volume, edited by the energetic Government Commissioner for the Care of Natural Monuments, Prof. Conwentz, contains a report of the congress, and a general report on the work of the past year up to March 31.

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[1] "Cave Vertebrates of America. A Study in Degenerative Evolution." By Prof. Carl H. Eigenmann. Pp. ix+241. (Washington: Carnegie Institution, 1909.)

[1] "Beiträge zur Naturdenkmalpflege." By Prof. H. Conwentz. Heft 3. Pp. 157–296. (Berlin: Gebrüder Borntraeger, 1909.) Price 2 marks.

The whole matter is another triumph of German organisation. Throughout the committees, which are interacting, are zoologists, ornithologists, botanists, geologists, and archæologists. The useful term "natural monument"—Alexander von Humboldt seems first to have employed it—includes practically everything indigenous which possesses scientific interest. In this report, for instance, which is well illustrated, there are accounts, not only of the *Porta Westfalica*, a human monument, but of interesting trees, "erratic" blocks of stone, moraines, diluvial sandstone formations, many characteristic specimens of the flora and fauna of the country, including various subdivisions, such as lichens and Lepidoptera. The term and the whole conception of the scheme are absolutely comprehensive. Many charts have already been prepared showing the local distribution of the "monuments"; such publications are of the highest scientific interest, especially when their subjects may still be counted on by the observer as existing in actuality.

It is to be hoped that this report may find its way to the hands of some English statesman. It gives an object-lesson of what can be done, and of how it may be done, to preserve the natural character of a country. In England the enclosure of sites and preservation of scenery too often result in the destruction of both fauna and flora. Where are the denizens, vegetable and animal, of White's Selborne? The present writer for many years had the privilege of research in a certain wild corner of Wensleydale which was as rich in rare plants and birds as any district in Great Britain. The ownership changed hands, and the whole of the wild life of the place was destroyed, first, by drainage for the purpose of making a coursing-ground, and later by operations connected with the water-supply of a great manufacturing town. This was vandalism no less brutal than the destruction of an exquisite statue.

It would be a profound satisfaction to lovers of nature if our country could be preserved in an efficient and comprehensive way. It is a work that could well be initiated by the Board of Agriculture. Dr. Conwentz, by the publication last year in English of his book "The Care of Natural Monuments, with Special Reference to Great Britain and Germany," has already given us a guide to both principle and execution. The present report—which can be read at one sitting—justifies his guidance.

A. E. Crawley.

THE MIGRATIONS OF PLAICE.[1]

The marking of plaice was commenced on the east coast of Ireland in August, 1905, and in a recent report Mr. G. P. Farran deals with such recaptures as have been made up to the end of 1907.

The principal plaice grounds on the coast of Ireland considered are within the areas prohibited to steam trawling, and the recaptures have been chiefly made by the local sailing trawlers and by line fishermen. In these circumstances it seems possible that here, as in other "prohibited" areas, some cases of recapture by steam trawlers may, for obvious reasons, be suppressed by the fishermen concerned.

Omitting certain fish liberated under unfavourable conditions, the total proportion of recaptured marked plaice stands at 46 per cent., from which Mr. Farran concludes that the local fishermen remove no inconsiderable portion of the stock of plaice on their fishing grounds. As an instance of how heavily a small area can be fished may be noted an experiment made in Skerries Bay. One hundred and eighty plaice were marked in April, 1906, out of which number no fewer than one hundred and nineteen, or 66 per cent., had been reported before the end of 1907.

In contrast to the long migrations which have been observed in the North Sea and at Iceland, very little tendency to extensive wanderings is shown by the plaice in these experiments. The majority were retaken within ten miles of the position of liberation. It is interesting to note that an inshore movement in the Dublin Bay area was evident in the autumn. A similar tendency has been noticed at this time of the year in some other parts of the British Isles, and is a well-known feature of the small plaice grounds off the Danish coast.

The choice of a suitable label for these experiments seems to have presented some difficulty. The German pattern of Dr. Heincke was found satisfactory for the size of fish most frequently met with, but unsatisfactory experiments were made with one or two other kinds. It seems curious that no attempt was made with the Petersen form of label, which has been successfully employed in the Danish, English, and other investigations, and, in Dr. Schmidt's classic experiments at Iceland, continued to be returned with the fish more than three years after their liberation.

Mr. Farran's mode of tabulating his data has certain disadvantages. The usual method adopted in recording recaptures is to take them in chronological order. Had this plan been followed instead of taking the consecutive numbers of the labels (an arrangement which seems to have little to recommend it), reference and comparison with the experiments of other investigators would have been facilitated.

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[1] Department of Agriculture and Technical Instruction for Ireland. Fisheries Branch. Scientific Investigations, 1907, No. iii.
"Plaice Marking Experiments on the East Coast of Ireland in 1905 and 1906." By G. P. Farran. Pp. 86+xxxiii plates. (Dublin, 1909.)

NOTES.

Political, municipal, industrial, and philanthropic activities are liberally represented in the list of Birthday Honours published on Tuesday, but science and other intellectual interests receive scant recognition. There are six new privy councillors, six new baronets, and thirty-two new knights in the list. Among the privy councillors is Sir Henry Roscoe, F.R.S., and among those who have received the honour of knighthood are Prof. W. A. Tilden, F.R.S., and Mr. E. H. Shackleton, the leader of the recent Antarctic expedition. Prof. A. H. Church, F.R.S., has been appointed a Knight Commander of the Royal Victorian Order (K.C.V.O.). Mr. T. L. Heath has been promoted to be Knight Commander of the Bath (K.C.B.), and Dr. Sven Hedin has been appointed an honorary Knight Commander of the Indian Empire (K.C.I.E.).

The following is a list of fellows who have been recommended by the president and council of the Royal Society for election into the council for the ensuing year:—*President*, Sir Archibald Geikie, K.C.B.; *treasurer*, Mr. Alfred Bray Kempe; *secretaries*, Sir Joseph Larmor, Prof. J. R. Bradford; *foreign secretary*, Sir William Crookes; *other members of the council*, Dr. H. B. Baker, Dr. W. H. Gaskell, Prof. E. H. Griffiths, Prof. Horace Lamb, Prof. H. M. Macdonald, Major P. A. MacMahon, Dr. C. J. Martin, Sir Andrew Noble, Bart., K.C.B., Prof. W. H. Perkin, Prof. E. B. Poulton, Prof. J. H. Poynting, Lieut.-Colonel David Prain, C.I.E., Prof. R. A. Sampson, Dr. A. E. Shipley, the Right Hon. Sir James Stirling, Dr. A. Strahan.

We regret to see the announcement of the death of Dr. W. H. Dallinger, F.R.S., on Sunday, November 7, at sixty-seven years of age.

SIR GEORGE DARWIN, K.C.B., F.R.S., has been elected an honorary member of the Calcutta Mathematical Society.

DR. J. J. DOBBIE, F.R.S., director of the Royal Scottish Museum, Edinburgh, has been appointed principal chemist of the Government laboratories in succession to Sir T. E. Thorpe, C.B., F.R.S., who has retired.

THE date of the annual exhibition held by the Physical Society of London, which was fixed some time ago for December 10, has been altered to Tuesday, December 14, so that the exhibition may be open in the afternoon as well as in the evening.

A REUTER message from Berlin states that in the course of excavations conducted by the Museum of Silesian Antiquities at Ottitz, near Ratibor, a clay figure representing a nude female divinity was unearthed in a Stone-age dwelling. The figure is said to be the most ancient model of the human form in existence.

AT the meeting of the Junior Institution of Engineers on Tuesday, November 16, the presidential address, on "The Propelling Machinery of Warships," will be delivered by Vice-Admiral Henry J. Oram, C.B., Engineer-in-Chief of the Fleet.

THE opening meeting of the Illuminating Engineering Society will be held on Thursday, November 18, at the premises of the Royal Society of Arts, when the inaugural address will be delivered by Prof. Silvanus P. Thompson, F.R.S., the first president of the society.

SIR ARTHUR RÜCKER, F.R.S., and Prof. Arthur Schuster, F.R.S., both members of the board of advisers of the Department of Terrestrial Magnetism, Carnegie Institution of Washington, made official visits to the magnetic survey yacht *Carnegie* while at Falmouth, inspecting the instruments and methods of work.

A REUTER message from Washington states that the National Geographic Society has awarded its gold medal to Commander Peary. The subcommittee appointed to examine the explorer's records and proofs reported that they afford conclusive substantiation of his claim to have reached the North Pole, and this report was unanimously accepted by the board of managers. The society has passed a resolution referring to a subcommittee of experts the question whether any explorer reached the North Pole before 1909.

SIR WILLIAM WHITE, K.C.B., F.R.S., chairman of the council of the Royal Society of Arts, will open the new session of the society on November 17 with an address, the subject of which will be "An Imperial Navy." Before Christmas there will be four ordinary meetings of the society, at which papers will be read by Mr. T. Thorne-Baker, on "Phototelegraphy"; the Hon. R. C. Parsons, on "Resilient Wheels for Vehicles"; Mr. J. Buckland, on "The Destruction of Plumage Birds"; and Mr. H. Pearson, on "The Diamond Fields of Brazil." One meeting of the Indian section will be held, at which Sir James Wilson will read a paper on "The Punjab," and Mr. Samuel Simpson will treat "Agricultural Development in Nyasaland" at a meeting of the Colonial section. There will be one course of Cantor lectures; in them Mr. C. C. Turner will give a popular account of the progress which has been made in aëronautics.

THE Hampstead Scientific Society inaugurated a new astronomical observatory and meteorological station on the southern margin of Hampstead Heath on Saturday. Mr. P. E. Vizard presided over a large meeting of the society in Heath Mount School, and short addresses were given on the value of the astronomical work which could be done by Dr. F. Womack, and on the meteorological work by Dr. H. R. Mill. Sir Samuel Wilks, F.R.S., referred to the efforts the society had made to secure this observatory, which has cost about 250*l.* The party then visited the observatory, which, by the kind permission of the Metropolitan Water Board, is placed on the top of the covered reservoir on the highest point of Hampstead, 450 feet above sea-level. The small astronomical observatory has a revolving dome, and contains an 8½-inch equatorial reflector by Grubb, presented to the Society by Dr. Womack. A sidereal clock has been presented by Mr. E. Duveen, and it is hoped that a driving clock will be added later. The meteorological equipment consists of a barometer in the observatory, a Stevenson screen with the usual thermometers, a rain-gauge and a sunshine recorder, all of them exposed in an unexceptionable manner, so that the observations cannot fail to be of much value for climatological purposes. Interesting comparisons may be looked for between the Hampstead records and those taken only a few feet above sea-level in St. James's Park. In a district so subject as London is to partial visitations of fog and thunderstorms, the multiplication of trustworthy meteorological stations in representative positions is much to be desired.

ARRANGEMENTS have been made for an International Congress of Radiology and Electricity at Brussels on September 6, 7, and 8, 1910, in connection with the exhibition to be held there. The congress will be held in three sections, and the subjects to be dealt with will include the following. In the first section, general questions of terminology and methods of measurement in radioactivity, and subjects connected with ions, electrons, and corpuscles will be dealt with. The second section will be divided into various subsections, dealing respectively with fundamental theories of electricity, study of radiations (including spectroscopy, chemical effects of radiations, and other allied questions), radio-activity, atomic theory, cosmical phenomena (including atmospheric electricity and atmospheric radio-activity). The third section will be biological, and will be devoted to consideration of the effects of radiations on living organisms. The sections will deal with purely biological questions as well as with the use of various radiations for medical purposes, both for diagnosis and therapeutics. In order to ensure the success of the congress, committees have been formed in the various countries which will take part in the congress, and the following men of science have already consented to act as presidents of the committee in each country:—Prof. Lenard (Germany), Prof. Exner (Austria), Prof. Oötvös (Hungary), Prof. Castillo (Spain), Prof. Barus (United States), Prof. Langevin (France), Prof. Rutherford (Great Britain), Prof. Blaserna (Italy), Prof. Birkeland (Norway), Prof. Lorentz (Holland), Prof. Ferreira da Silva (Portugal), Prof. Hurmuzescu (Roumania), Prof. Lebedew (Russia), Prof. Arrhenius (Sweden), and Prof. Guye (Switzerland). Communications regarding the congress should be addressed to Prof. Rutherford or Dr. W. Makower at the University of Manchester; or to Dr. W. Deane Butcher, Holyrood, Ealing, London, W., for matters connected with the biological and medical section. Intending members should communicate directly with the general secretary, Dr. J. Daniel, 1 rue de la Prévôté, Brussels.

SOME of the friends and former pupils of the late Prof. Arthur Gamgee have thought that they could best mark their high appreciation of his great scientific attainments and single-hearted devotion to the prosecution of knowledge by forming a fund which should be of material benefit to his family—a widow and two daughters. Prof. Gamgee was widely known both in this country and abroad—he had, indeed, a European reputation—and it has seemed to those who have given their support to this fund, which was initiated some months ago, that it might be possible to augment still further the capital sum which it is desired should be raised if a knowledge of the objects of the fund was more widely spread, so that those who may wish to help should be invited to subscribe. It is not intended that any list of subscribers should be published. Towards the end of this month there will be a meeting of those who are in sympathy with the view that the raising of such a fund for his family would be the best and wisest appreciation of Prof. Gamgee's life-long devotion to science. The date and place of this meeting will be duly announced. Subscriptions may be sent to Prof. Arthur Schuster, Victoria Park, Manchester; Dr. A. D. Waller, Physiological Laboratory, University of London, S.W.; or Dr. G. A. Buckmaster, University College, London, W.C.

To the second half of the "Bergens Museum Aarbog" for 1909 Mr. Haakon Schetelig contributes an article on Norwegian antiquities received by the museum in 1908. The specimens include a roughly chipped stone implement from Vespestad; a bench of pine-wood from Hammer Church, Nordhordland; a portion of an iron sword, with silver mountings on the scabbard, from Sondhordland; a stone axe from Sogn; a flint javelin-head from Hardanger; and a bronze brooch from Lofoten.

In a paper published in vol. xxii., part i., of the Proceedings of the Royal Society of Victoria, Miss Morris and Miss Raff direct attention to certain features in the structure of the Australian lancelet, *Assymetron bassanum*, which have either escaped previous notice or have been inadequately described. The species in question occurs locally in depths up to 20 fathoms along the coasts of Victoria, and is commonly used in the laboratories of the colony in place of the typical Amphioxus. In another paper in the same issue Miss Buchanan commences a detailed account of the anatomy of Australian earthworms, dealing in this instance with the blood-vascular system, which is illustrated in the different species by diagrams.

In vol. xvii., No. 6, of the Proceedings of the Royal Physical Society of Edinburgh, Dr. Campbell Geddes directs attention to the extraordinary individual variation to be met with in the degree of development of the muscular impressions, crests, or tubercles of the appendicular skeleton of the human subject, and the inferences to be drawn therefrom. In the author's opinion such surface-details of the bones of the skeleton are only indirectly dependent on age, sex, and muscular activity, and are not, as Topinard believed, an index of the absolute muscularity of the individual. On the contrary, they depend directly upon, and therefore serve as an index to, the type of nutrition which the somatic cells of the individual enjoyed during life.

The origin and flora of the salt-marshes, salt-ponds, and fresh-water lakes of the northern coast of New Jersey have been studied by Mr. J. W. Harshberger, who gives the results of his investigations in the August issue of the Proceedings of the Academy of Sciences of Philadelphia. Such lakes and ponds are due to the advance of sand-dunes across the outlets of streams arising some distance inland. Most of the larger streams that have kept their outlets open are bordered for some distance from the sea with a characteristic salt-marsh vegetation. As the bars encroached on the outlets of the streams the water became brackish, and the salt-marsh plants gradually disappeared with the decrease of saltness. Finally, near the heads of several of the bays, as well as in some of the smaller ponds, the water becomes more and more fresh, and the salt-marsh plants are replaced by those accustomed to grow in or near fresh-water streams. Similarly, salt-ponds have become slowly changed into fresh-water lakes, with a corresponding alteration of the vegetation.

We have received the report on the progress and condition of the U.S. National Museum for the year ending June 30, 1908, in which detailed information is given as to the work accomplished on the new building up to that date, with illustrations of the complete structure. The progress of the work was considerably delayed owing to the failure of contractors to deliver the full complement of granite within a specified period. During the year under review the ethnological section of the museum was very largely augmented by collections illustrative of the natives of Borneo and the Philippines, the cliff-dwellers of Arizona, the Zuni Indians of New Mexico, and the Tahltau Indians of British Columbia. Mammals and birds from Malaya, the Philippines, and Costa Rica bulk largely among the additions to the zoological section, and the collections of fishes and invertebrates were largely augmented by the final distribution of the specimens obtained during the exploring cruise of the *Albatross* in the Pacific.

The nematodes come in for a large share of attention in the latest number of the *Zeitschrift für wissenschaftliche Zoologie* (Bd. 93, Heft iv.), in which Mr. E. Martini continues his studies on the subcuticula and lateral areas, and Dr. Fr. Bílek deals with the fibrillar structures in the muscle and intestinal cells of ascarids. Dr. Bílek's memoir, with its beautiful illustrations, constitutes a noteworthy addition to our knowledge of invertebrate cytology.

Messrs. Sanders and Co., Shaftesbury Avenue, have issued a very complete series of lantern-slides, 270 in all, illustrating spiders and their habits, a number of which we have had the opportunity of inspecting. The photographs were taken from nature by Mr. Richard Hancock, and show great manipulative and artistic skill. The series, of which a complete catalogue is also published, should be of great use to popular lecturers.

The *Journal of Morphology* for October (vol. xx., No. 3) contains two important cytological papers. In his "Observations on the Oökinesis in *Cerebratulus lacteus*," Naohide Yatsu describes the phenomena of maturation and fertilisation of the egg and its early cleavage stages. He deals especially with the behaviour of the "centriole," or, as English cytologists generally term it, the "centrosome," the latter term being used by the present author to designate the "centroplasm" which surrounds the "centriole," in other words, what is often termed in this country the "centrosphere." It is evident that the terminology of cytologists is in a somewhat confused state. Yatsu maintains the view that the middle piece of the spermatozoon carries a centriole into the egg at fertilisation, and that this gives rise by division to the cleavage centrioles.

Another paper in the *Journal of Morphology*—"Comparative Studies in Crustacean Spermatogenesis"—by M. Louise Nichols, besides the author's own observations, contains a useful *résumé* of the work of previous writers on the morphology of the crustacean spermatozoon. It seems that, according to Koltzoff, the curious immobile spermatozoon of the higher Crustacea is constructed very much on the principle of a cartridge. After the spermatozoon has become attached to the egg by means of its processes, the "capsule" explodes and drives the nucleus and centrosome into the egg. The same journal also includes an interesting account of the life-history and habits of *Chaetopterus variopedatus* by Mr. H. E. Enders, and a very full account of the development of the procephalic lobes of *Epeira cinerea* by Mr. A. E. Lambert, while Mr. Walter Meek contributes a description of the structure of the heart muscle of Limulus.

A PRELIMINARY revision of Philippine Myrtaceæ, by Dr. C. B. Robinson, published in the *Philippine Journal of Science* (Botany, vol. iv., part iii.), is primarily noteworthy for the number of species, just short of a hundred, described under the genus Eugenia. This is largely due to the incorporation under Eugenia of the segregates Jambosa and Syzygium, to which the greater number of species belong. Fully half the species are new types, and a considerable proportion of the remainder are endemic. Most of the Eugenias are trees yielding timber of value, although none supplies timber so commercially important as the myrtaceous tree *Xanthostemon verdugonianus*. Outside the genus Eugenia the family is poorly represented by a dozen species distributed over nine genera.

A NOTE on *Fomes lucidus*, one of the Polyporaceæ, contributed by Dr. E. J. Butler to the *Indian Forester* (September), deals with the probable parasitism of this fungus, as previously suggested by Dr. Raciborski. The author mentions a number of cases of fungal diseases, reported from different parts of India, on such different trees as Casuarinas, betel-palm, *Dalbergia Sissoo*, in which the source could not be definitely traced, but in all of which *Fomes lucidus* was found to be present; inoculation experiments are required to decide the question. In the same issue there are good illustrations of hills in the north Arcot division, Madras, showing the absence of tree growth in unprotected and protected but grazed areas as compared with the growth on a fully protected and partially planted area. For reproduction *Pterocarpus santalinus*, Red Sanders, proved to be better than *Terminalia tomentosa*, teak, or other species that were tried.

A FINE catalogue of plants, bulbs, and seeds has been issued by Messrs. Kelway and Son, of Langport, Somerset. The firm makes a special feature of hardy perennial plants, and their list of species in this section may be regarded as complete, but the catalogue is even more noteworthy in the selection of varieties offered under those plants that have been special objects of cultivation. The records of the Royal Horticultural and Royal Botanic Societies bear testimony to the splendid varieties of delphiniums, gaillardias, pyrethrums, and gladioli raised by Messrs. Kelway, and, above all, of pæonies, herbaceous, "imperial," and tree; the firm also raise their own forms of other favourites, such as zonal pelargoniums, hollyhocks, and phloxes. The catalogue cannot fail to arouse the enthusiasm of all garden-lovers; it is eminently practical in arrangement, description, and directions, is illustrated with choice photographic reproductions, and contains a few coloured plates taken in colour direct from the object.

AN account of the Peruvian National School of Agriculture is given in a new monthly publication entitled *Peru To-day*. The country possesses a rich soil and a climate enabling tropical products to be grown as well as those of the temperate zones. The coast is said to be well adapted to cotton raising; sugar and rice are also grown besides the ordinary cereal and other crops. A model vineyard has been started, and also an experimental sugar-cane station.

WE have received from Messrs. Pearl and Surface a paper on selection index numbers and their use in breeding, in which the authors discuss the case, commonly arising in practice, where it is desired to improve two or more features at the same time. Each of the several characters shown by the plant or animal receives a certain value, positive or negative. The sum of these values for each individual constitutes its index number. Those individuals with highest index numbers are then selected and used for breeding.

IN a recent number of the *Journal of Economic Biology* Mr. Southern describes a new species of Rhabditis, *R. brassicae*, discovered in a turnip in an advanced state of decomposition. The nematode worms commonly known as "eel worms" are found in water, soil, and decaying organic matter, and are responsible for a certain amount of damage to plants. Some genera, such as Tylenchus, are provided with a spine, by means of which the epidermis of the plant can be pierced and its juices sucked. In Rhabditis, however, this piercing apparatus is absent, and the author kept large numbers of the worms on the surface of a turnip for a month without the epidermis being affected; but once a way in was found, the worms were enabled to feed on the juices by means of their powerful sucking pharynx.

CONSIDERABLE attention is devoted to the culture of maize by the Transvaal Agricultural Department, and an account of the varieties most suitable is given by Mr. Burtt-Davy in the *Transvaal Agriculture Journal*. Dent maize is best for the main crops, as it usually gives the best yields and is in greatest demand; flint maize, on the other hand, is more suitable for districts where the rainfall is limited. Of the different varieties of dent maize Hickory King is most promising for the export trade, as it is purchased by corn-flour manufacturers, distillers, and brewers; by producing a choice grade of this variety still more profitable results may be obtained. Yellow varieties are grown for stock-feeding purposes.

THE quarterly issue of the *Eugenics Review* for October maintains the standard of former parts. In addition to the usual editorial notes and reviews, there is a short contribution by the honorary president, Sir Francis Galton, on the effects of small and persistent influences in moulding public opinion, and special articles on various aspects of eugenics. The note by Dr. Havelock Ellis directing attention to the sterilisation, on social grounds, of four mentally defective persons in Switzerland, and the Rev. J. H. F. Peile's discussion of the relation of the Church to the eugenic movement—a pressing and difficult problem—are, perhaps, of most general interest. It is to be regretted that the article by Dr. Slaughter, on selection in marriage, should be open to the criticism of Mr. Peile that much of the literature of eugenics is unconciliatory and dogmatic in tone. The adoption of a polemical style is inappropriate in a scientific contribution to the discussion of the subject, and defeats its own end in an article written for propagandist purposes.

THE *Century Magazine* for November contains a popular article, by Prof. Metchnikoff, on the utility of lactic microbes in the diet, their mode of action, and an explanation of the author's views on longevity.

THE winter session of the London School of Tropical Medicine was opened on October 26 by Mr. Whitelaw

Reid, the American Ambassador, when Prof. Osler delivered a masterly address on the progress of tropical medicine and the benefits resulting therefrom. Prof. Osler urged the great need there is for further extension in research on diseases of the tropics.

Considerable activity is being manifested in the attempt to cope with the plague of sleeping sickness in Africa. The Sleeping Sickness Bureau, under the direction of Dr. Bagshawe, has issued its tenth Bulletin, containing a summary of researches on trypanosome diseases, their pathology and treatment; also a progress report on the Uganda sleeping sickness camps from December, 1906, to November, 1908, compiled by Dr. Hodges, the principal medical officer, Uganda. The welcome statements are made that sleeping sickness is greatly on the decrease in Buganda kingdom, and that the drug atoxyl at least prolongs life, and in exceptional cases is curative. A bibliography of trypanosomiasis and tsetse-flies, embracing papers published prior to April, 1909, and compiled by Major C. A. Thimm, of the Sleeping Sickness Bureau, is in the press.

In *Symons's Meteorological Magazine* for October, Mr. C. Harding gives an interesting note, with diagram, of the summer weather (April–September) experienced in London and the suburbs during the last fifty years, prepared from the records of the Greenwich Observatory. The average number of warm days, on which a temperature of 70° and above was reached, was seventy-four; the greatest number of warm days was 127, in 1865. The last ten years, with the exception of 1906, have been cool. The average rainfall for the summer season is 12·29 inches —an amount which was exceeded this year by 1·80 inches.

A new barograph for recording minute and rapid oscillations of atmospheric pressure, invented by Mr. T. Shida, is described in the Proceedings of the Tokio Physical Society for April last. By a simple plan an aneroid barometer is made to record photographically; for the purpose of magnification, Kelvin's bifilar method is applied directly to a Bourdon tube, as used by Darwin and others. To protect the instrument, the whole system is enclosed in an air-tight case, with the exception of a small window provided with a lens for photographic registration. The case and tube have each a short piece of metal tube with stop-cocks communicating with the atmosphere. Specimens of the records are appended to the paper; the period of oscillation at Tokio was generally about six seconds, vibrations with the period of twelve seconds being most conspicuous. The author thinks that such observations may eventually explain the true cause of the pulsation of the ground.

A copy of "Studies in Practical Topography," by Mr. H. T. Crook, published by the Manchester Tactical Society, has reached us. Mr. Crook vigorously criticises the prepared sheets issued for some recent military examinations in a chapter entitled "The Land of (*d*)1," and gives three interesting topographical studies on Ruthin and the Clwydian range, Ilkley Skipton and the Pennines, and the Ribble Valley.

An excellent example of detailed geographical study of a small area appears in a paper, published in the *Mitteilungen* of the Vienna Geographical Society (vol. lii., No. 9), on the town of Graz. The author, Dr. G. A. Lukas, discusses the position, soil, water supply, climate, flora and fauna, and population of Graz and its neighbourhood with much detail, and the paper is accompanied by a geological map by Dr. Franz Heritsch. Specially interesting is the examination of the relation of local and outside conditions, and of the historical events which finally gave Graz the predominance over the equally well-situated Wildon.

A new series of calculating tables, by Dr. J. Peters, is announced (Berlin: Georg Reimer). The tables are to contain the products of all numbers of four figures by the numbers 1 to 100, so to multiply together two numbers of four figures it is only necessary to take two partial products from the tables and add them together, *i.e.* the multiplication is performed in two lines, which are written down from the tables.

A project for the formation of a museum of aërial navigation has been started under the auspices of the authorities of the Frankfurt Exhibition, the Frankfurt Aëronautical Society, the Physical Society, and other bodies in Frankfurt. It is pointed out that aërial navigation has a small past and a great future, and that the recent exhibition affords an excellent nucleus for a collection which can never be complete unless it is founded in the early days of the subject.

In view of the exaggerated importance attached to aëroplane record-breaking feats by the unscientific public, it is somewhat of a relief to turn to Mr. Gerald Biss's criticisms in the *Standard* of October 26. Great stress is laid on the power of individuality as a factor in present-day flights, it being pointed out that it was Mr. Latham's individuality which made his wonderful flight of the previous Friday possible. In a paragraph headed "When Aviation is Farcical," Mr. Biss says:—"The truth of the matter is, in a nutshell, that the progress of aviation has been greatly overwritten by ignorant enthusiasts and is still in the days of its earliest infancy. After the present boom, which will, I am sure, be far more short-lived than either the cycle or the motor boom, it will behove designers to sit down and work out the questions of automatic stability, vertical rising, compactness to the point of the practical, security against sudden dropping, and so on. . . ."

The view generally held that in the liquefaction of gases in the Linde or Hampson apparatus the cooling is due to the Joule-Kelvin effect has been attacked by Pictet in a series of articles which have appeared in the technical Press during the last half-dozen years. He has put forward an expression for the cooling which makes it depend on the work the gas does in overcoming the pressure in front of the expansion valve, and implies that it increases with increase of initial temperature and is almost independent of the fall of pressure. Messrs. W. P. Bradley and C. F. Hale, of the Wesleyan University of Connecticut, have made an extensive series of experiments on the cooling of the air in a liquefying apparatus in widely differing circumstances of pressure and temperature, and have found that the facts are qualitatively in agreement with the original theory, although there are quantitative differences to be explained, while they are diametrically opposed to the Pictet theory. The memoir is contained in the September number of the *Physical Review*.

In a paper entitled "The Elastic Breakdown of Non-ferrous Metals," read at the recent Manchester meeting of the Institute of Metals, Prof. C. A. Smith, of the East London College, describes the special strain-measuring appliance called the sphingometer, devised and used by him for the tension, compression, and torsion strips. There were five conditions which the instrument was required to fulfil, namely, (1) to determine the maximum, as well as the mean stress, on the material tested; (2) to be easily adapted to specimens of varying diameters; (3) to be easily adapted to specimens of varying length; (4) to measure accurately strains of at least one hundred-thousandth part of an inch; (5) to be of reasonable expense. The results of a large number of tests made with the instrument are given. These tend to prove that copper, aluminium, and other non-ferrous metals have very varying elastic properties, and it is consequently impossible to establish any definite law for elastic failure. It appears, however, that elastic failure always does take place according to a law which approximates closely to the maximum shear-stress theory.

IN an article on the development of modern road surfaces in the Journal of the Franklin Institute for October, Mr. W. H. Fulweiler divides the methods of applying tar into three general heads:—(*a*) Brushing with a hot coating of coal-tar and dusting it lightly with sand; in general use in France. (*b*) Painting the surface by machine and dusting with sand; in general use in England. (*c*) Coating the surface with a fairly heavy coating of hot tar or tar compounds, and then covering with a light coat of screening, the surface being finally rolled. The latter is the general system adopted in America, and seems to be better adapted to the rougher surface of American roads. A refined grade of tar, considerably heavier than that used in France or England, is used, having more body and greater binding properties, and the coating applied is about twice as heavy. A light coating of clean gravel or fine stone chips is then put on instead of sand and rolled, thus renewing the wearing surface and filling the voids better than can be done by the use of sand. The treatment produces deeper penetration and more lasting effect, and succeeds best on macadam roads. It is practically mud-proof, absolutely free from road dust, apparently proof against very heavy motor traffic, and is the most satisfactory for American conditions. The cost is higher than that of the French and English methods.

AN interesting pamphlet dealing with water-hammer in steam pipes has been issued by Mr. C. E. Stromeyer, chief engineer of the Manchester Steam Users' Association. According to the Board of Trade reports, water-hammer has been the cause of about 120 steam-pipe explosions. Mr. Stromeyer finds that nearly one-half of these have been due to the absence of drain-cocks on steam pipes, or to their injudicious use. A large number, chiefly on steamers, have been produced by admitting steam into pipes containing water. Others have occurred when water was admitted into steam pipes, or when steam condensed in them. Steam being admitted through valves on which water was resting, injudicious opening of valves having steam and water on both sides, and injudicious manipulations of steam valves, whereby plugs of water have been set in motion, have all contributed to swell the total of explosions. Mr. Stromeyer considers it inadvisable to lay down at present definite rules for the design of pipe arrangements in general, having been led to this conclusion by the fact that draining arrangements, designed to obviate explosions, have caused the majority of accidents, and also because in many cases of complicated pipe arrangements the water-hammer may often be attributed to any of the above-mentioned causes. Mr. Stromeyer complains of the insufficiency of the official reports of explosions having given him much difficulty in arriving at definite conclusions.

MR. W. B. CLIVE, of the University Tutorial Press, Ltd., has published a second edition of "First Stage Sound, Light and Heat." The book has been revised and re-written by Dr. R. W. Stewart, who has introduced a course of experimental work. The price of the book is 2*s.*

IN connection with the Winnipeg meeting of the British Association last August, the *Manitoba Free Press* published a series of illustrated biographical sketches of the president, Sir Joseph Thomson, F.R.S., the presidents of the sections, the evening lecturers, and the general officers of the association. These biographies have now been re-issued in pamphlet form at the price of 50 cents. Copies of the booklet can be obtained from Mr. A. V. Thomas, c/o *Manitoba Free Press*, Winnipeg, at 7½*d.* each.

WE have received a copy of the second part of vol. xiii. of the Transactions of the Leicester Literary and Philosophical Society. The booklet contains abstracts of lectures delivered before the society, the report of the council, and the annual reports of the sections of the society presented at the annual general meeting in May. The report states that the balance of the fund raised in connection with the visit to Leicester, in 1907, of the British Association has been voted to the council of the society for investment as the nucleus of a fund, the interest accruing from which is to be devoted in a manner to be decided by the council, annually, or at such times as the council may determine, to the development of local scientific knowledge, including that bearing upon the industries of the town. A cheque for 80*l.* has been received, and the council has appointed a special committee to consider and report as to the best means of applying the money in furtherance of the object intended.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN NOVEMBER:—

Nov. 11.	10h. 27m.	Mercury in conjunction with the Moon. (Mercury 1° 21′ S.).
16.	16h. 27m.	Venus in conjunction with the Moon. (Venus 0° 6′ S.).
,,	19h. 0m.	Vesta in conjunction with the Moon. (Vesta 1° 15′ N.).
17.	5h. 39m.	Uranus in conjunction with the Moon. (Uranus 3° 0′ N.).
22.	10h. 11m.	Mars in conjunction with the Moon. (Mars 4° 26′ N.).
23.	13h. 15m.	Venus in conjunction with Uranus. (Venus 2° 33′ S.).
,,	14h. 53m.	Saturn in conjunction with the Moon. (Saturn 1° 32′ N.).
,,	7h. 39m.	Minimum of Algol (β Persei).
26.	20h. 55m.	Eclipse of the Moon, partly visible at Greenwich.
,,	4h. 28m.	Minimum of Algol.
29.	23h. 22m.	Neptune in conjunction with the Moon. (Neptune 4° 14′ S.)

RE-DISCOVERY OF WINNECKE'S COMET (1909*d*).—A telegram from the Kiel Centralstelle announces that Winnecke's comet was re-discovered at the La Plata Observatory, Argentina, on October 31. Its position on that date at 8h. 14·1m. (La Plata M.T.) was 17h. 11m. 51·6s., −27° 18′ 43″, and its magnitude was about 10·0; this position lies a little to the south-west of θ Ophiuchi. According to Prof. Hillebrand's elements, the perihelion passage took place on October 4·0 (G.M.T.).

HALLEY'S COMET.—According to a note in the November number of the *Observatory*, Halley's comet is steadily increasing in brightness, and ten minutes' exposure, presumably with the Greenwich 30-inch reflector, gives a strong image. Reproductions of photographs are given in the *Observatory* (Greenwich, September 23), *Knowledge*, and the *Astrophysical Journal* (Yerkes Observatory, September 16, 17, 24, and 26). The *Observatory* (No. 415, p. 435) also gives an ephemeris for April and May, 1910, the time of perihelion passage being taken as April 19·65

G.M.T. From this we see that the nearest approach to the earth should occur on May 20, the distance then being 14·3 million miles. The revised elements indicate that the comet should transit the sun's disc on May 18d. 14h., but the transit will, of course, be invisible in Europe. It appears possible that, at that time, the comet's tail may extend beyond the earth and be visible in the midnight sky.

From observations made with the 40-inch Yerkes telescope Prof. Barnard concludes that the comet is brightening rapidly, and was not fainter than magnitude 13·5 on October 17–19; the diameter was estimated at 15″, the comet being a little brighter towards the centre.

The Astronomischen Gesellschaft prize has now been definitely awarded (*Astronomische Nachrichten*, No. 4366) to Messrs. Cowell and Crommelin.

SATURN.—A telegram from the Flagstaff Observatory announces that the lacings crossing Saturn's equatorial bright belt, detected at that observatory, have now been photographed there (Circular No. 114, Kiel Centralstelle).

MERCURY.—From the careful study of some twenty photographs, taken at the Massegros Observatory during the elongation of September last, M. Jarry-Desloges arrives at the conclusion that the rotation period of Mercury coincides with the period of revolution. The photographs show a number of details (*Astronomische Nachrichten*, No. 4366, p. 375, November 1).

THE "FLASH" SPECTRUM WITHOUT AN ECLIPSE.—Yet another important development in solar spectroscopy emanates from Mount Wilson, Messrs. Hale and Adams, in No. 3, vol. xxx., of the *Astrophysical Journal*, describing the apparatus and method whereby they have succeeded in photographing the bright-line spectrum of the lower chromosphere without waiting for a total eclipse. With their apparatus such photographs may now be obtained at any time when the sun is observable.

After describing the previous attempts to attain this end, made at Kenwood, Yerkes, and Meudon, they give a brief description of the additions to the 30-foot spectrograph which enabled them to accomplish it.

The main difficulty in such photography is to keep the solar image exactly tangential to the slit, but they have overcome this by fitting a slipping-plate over the slit-plate. This slipping-plate is moved, parallel to the slit-plate, by a fine screw, and carries a right-angled prism which reflects the image of the limb on to a second, similar, prism fixed in front of the slit so as to reflect the rays between the slit jaws. The observer watches the spectrum, and by moving the slipping-plate preserves the tangential position, which gives the "flash" spectrum, throughout the exposure. The tower telescope gives a solar image of 6·7 inches diameter, and a grating having 568 lines per mm. on a ruled surface 49 mm. by 82 mm. is employed; better results are anticipated when the new 150-foot tower telescope becomes available. At present provisional wave-lengths are given for 124 "flash" lines, which are tabulated to show coincidences with Rowland's solar lines and with the eclipse lines observed by Evershed, Frost, Jewell, and Lockyer, respectively. The deviation of the wave-lengths of these lines from those given by Rowland for the corresponding solar lines is less than the probable error of measurement; if the bright lines of the "flash" spectrum were due to anomalous refraction at the sun's edge, as suggested by Julius, the two sets of wave-lengths should differ considerably.

SEARCH-EPHEMERIS FOR GIACOBINI'S COMET, 1896 V.—A revised set of elements for the comet discovered by Giacobini on September 4, 1896, is published by that observer in No. 4364 of the *Astronomische Nachrichten*, and gives the probable date of perihelion passage as December 19, 1909.

Three search-ephemerides are also given, one assuming that perihelion will occur on December 19·364, the others for ten days before and after, respectively. The position for November 4 is $\alpha = 18\text{h. } 13 \cdot 1\text{m.}$, $\delta = 15° \ 1'$ S., and the brightness is given as 0·58, unity being about equivalent to magnitude 12·0. The southerly declination and comparative faintness of the object render it unlikely that the comet will be observable, if found, except by the largest instruments.

THE UPPER AIR.[1]

THE past decade has been very fruitful in the investigation of the upper air. By the use of kites sufficient results have been obtained to furnish a tolerably complete knowledge of the variation in the meteorological elements up to a height of 2 km., while registering balloons have furnished information regarding the distribution of temperature up to heights of 15–20 km. The results of the Berlin manned balloon ascents were arranged and discussed very fully ten years ago, but no such comprehensive discussion of the much more numerous kite and registering balloon ascents has yet been attempted. The present report deals with the instruments and methods of investigation, and with the results for temperature and for wind.

The most important series of the earlier ascents with manned balloons was that made by Glaisher in 1860–70. Unfortunately, he was led to believe that artificial ventilation of the thermometers was unnecessary, with the result that his observations at great altitudes are untrustworthy. In the series of ascents made from Berlin in 1888–95, observations made with careful ventilation proved beyond doubt that large errors would arise in the absence of proper ventilation, and that Glaisher's results were almost certainly affected by such errors.

The following table shows the nature of the errors, and incidentally furnishes a comparison with one of the earlier *ballon-sonde* ascents :—

Height, metres	Fall of temperature ° C. per 1000 metres		July 31, 1901	
	Glaisher	Berson	Berson and Süring	Ballon-sonde
0–1000	7·5	5·0	7·2	8·3
1000–2000	6·5	5·0	6·8	6·1
2000–3000	5·0	5·4	3·7	4·2
3000–4000	4·2	5·3	5·2	5·1
4000–5000	3·8	6·4	7·4	5·7
5000–6000	3·2	6·9	5·5	6·3
6000–7000	3·0	6·6	7·2	4·7
7000–8000	2·0	7·0	7·2	7·6
8000–9000	1·8	9·0	3·6	7·1

Temperature observations in manned balloons are now usually taken with an Assmann's aspirator, in which a ventilating current of about 4 m.p.s. is forced by a fan through a polished tube containing the thermometer and screening it from radiation.

The instruments used with registering balloons are of two types. In the large type the record is made on a metal or photographic sheet, covered with lamp-black, and wrapped round a revolving cylinder driven by a clock. Pressure, temperature, and humidity are recorded by separate pens. The barometer is a Bourdon tube or an aneroid, the thermometer some form of bimetallic instrument, and the hygrometer a bundle of hairs. In the small type the temperature record is traced on a cylinder or plate, which is itself moved at right angles to the direction of motion of the temperature lever by the changes of pressure. The temperature and pressure are then given by the ordinates and abscissæ of the trace obtained. The advantage of this arrangement is that no clock is required, and the instrument can be made much lighter and is more easily tested. The loss of the humidity trace is unimportant, because the hygrometric records at low temperatures are very untrustworthy, and the observations in the lower layers can be made with kites or manned balloons.

The instruments used with kites are similar to the *ballon-sonde* instruments of the larger type, but they have an arrangement for recording wind velocity. In the Dines instrument the records are traced on a flat, circular sheet of cardboard rotated by means of a clock and resting on a wooden tray beneath which the instruments are placed.

The *ballon-sonde* instruments are tested either (1) by keeping the thermometer at ordinary atmospheric pressure in testing for temperature, and the barometer at ordinary temperatures in testing for pressure, or (2) by testing the thermometer through the temperature range at different pressures and the barometer through the pressure range at different temperatures. The second is, of course, the more desirable plan, but the difficulties involved in applying it to the larger type of instrument are so considerable that the former method is generally adopted where such instruments are used. The simplicity of the smaller type of instrument devised by Dines enables the second method to be adopted in testing it, without elaborate and expensive apparatus.

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[1] Report on the Present State of our Knowledge of the Upper Atmosphere as obtained by the use of Kites, Balloons, and Pilot Balloons." Report of the Committee, consisting of Messrs. E. Gold and W. A. Harwood, presented at the Winnipeg meeting of the British Association, 1909.

Temperature records obtained simultaneously with different instruments show differences which, in the mean, do not exceed 1° C., and the temperatures may, in general, be taken to be correct to this degree of accuracy, but lagging of the instruments makes it doubtful if in all cases the recorded temperatures and heights actually correspond.

In dealing with the observations, it is found convenient to express temperatures in degrees C. above the absolute zero, −273° C. on the ordinary scale. Where necessary the letter A is used to characterise this scale. Atmospheric temperatures, both at the surface and in the upper air, lie almost always between 200° A and 300° A, so that the 2 may be dropped without risk of confusion. Gradients of temperature are expressed in degrees C. per km., and are reckoned + when temperature decreases upwards.

The mean value of the gradient up to 3 km. is as follows:—

	°
From the Berlin manned balloon ascents, 1888–1897	5·1
,, ,, ,, .. 1897–1907	4·8
,, Berlin and Lindenberg kite ascents	4·7
Calculated by Hann from mountain observations	5·7

It follows from these results that the mountains are colder than the free atmosphere at the same height, and many observers have verified this fact by direct comparison. Shaw and Dines found that in July, 1902, the temperature on Ben Nevis was 2·6° C. below that of the free atmosphere at the same height to the west of the mountain. Schmauss found that the temperature on Zugspitze (nearly 3000 m.), which lies on the northern edge of a mountainous region, was continually lower than that of the free atmosphere, but was higher than that at the same height on Sonnblick, which lies in the middle of the Alps.

It was pointed out by Von Bezold that increase of temperature on a mountain is limited by convection, whereas no immediate limit is set in this way to cooling. There is a one-sidedness in the heat exchange between the mountain surface and the atmosphere which would tend to produce the result found by observation. Moreover, convection always tends to raise the temperature of the upper air above what it would be otherwise, and, in addition, the cold of winter is, as it were, stored up in the snow, while no such process holds for the warmth of summer. Both conditions are probably effective in increasing the temperature difference. The most important deduction to be made from the results is that the mountains are not cold because the upper air is cooled by convection, but they are cooled by their radiation to space.

The mean values of the gradients up to 15 km., found from registering balloon ascents at ten European stations and for St. Louis, U.S.A., are given in the table:—

Height		0–1	1–2	2–3	3–4	4–5	5–6	6–7	7–8 km.
Gradient	Europe	3·6	4·3	5·2	5·8	6·3	6·8	7·2	7·4
	St. Louis	5·1	5·3	4·7	5·2	5·9	6·2	[illegible]	[illegible]

Height		8–9	9–10	10–11	11–12	12–13	13–14	14–15 km.
Gradient	Europe	6·8	5·0	3·3	0·7	−0·8	0·0	−0·1
	St. Louis ...	7·4	6·7	5·5	2·9	1·4	0·6	−0·9

The maximum value occurs in the layer 7–8 km., and its magnitude indicates that the effect of radiation is to leave practically unchanged the natural gradient in air in vertical motion. Gold showed that in the upper layers absorption exceeded radiation, and in the lower layers radiation exceeded absorption, and both processes would diminish the temperature gradient. At an intermediate stage absorption and radiation must balance, and the results indicate that this is the case at a height of 7–8 km. The temperature at different heights up to 15 km. shows practically no variation for the ten European stations except in the case of Pavlovsk, where the temperature is uniformly lower up to 10 km. and higher above 10 km. than at the other stations. The difference of temperature between Strassburg and Pavlovsk, taken to represent lat. 50° and lat. 60° respectively, is sufficient to produce a gradient of pressure at a height of 10 km. which would correspond to a steady west wind of about 24 m.p.s. (54 miles per hour). The difference between Strassburg and St. Louis (representing lat. 39°) would at the same height correspond to a steady west wind of 15 m.p.s. in intermediate latitudes. The observations are not sufficiently extensive to warrant much stress being laid on the absolute values of these velocities, but it is of interest to note that the approximate ratio of the west winds in lats. 45°, 55°, deduced from Oberbeck's solution by a purely theoretical treatment of the problem of the general circulation, is 16/21 for the upper strata, a result in tolerable agreement with the ratio 15/24 deduced from the temperature observations.

The problem of the vertical distribution of temperature in cyclones and anticyclones depends for its solution on upper-air observations. Hann deduced from the temperatures at high-level observatories that cyclones were colder than anticyclones, the mean difference of temperature up to 3·5 km. being as much as 5° C. Grenander found similar results by a consideration of the kite and balloon ascents at Hald and Berlin, while Von Bezold deduced from the Berlin manned balloon ascents that the relative coldness of the cyclone was maintained even up to 8 km.

The results in the present report, obtained by taking only those cases in which the sea-level pressure exceeded 770 mm. or was less than 750 mm., and correcting the observations for seasonal and local variations, showed that the cyclone was colder than the anticyclone up to 9 km., while at greater heights the conditions were reversed, and the anticyclone became much colder than the cyclone; but the effect of the temperature difference in the lower layers on the pressure difference is so considerable that even at 14 km. the pressure gradient is not reversed. In these circumstances it is difficult to see how air can be brought into the anticyclonic and out of the cyclonic regions in the upper air. The cirrus observations imply a definite outward motion over cyclonic regions, but a rotation in the same direction as at the surface, which can be the case only if the gradient of pressure is also in the same direction as at the surface. These results imply that there is motion across the isobars from the lower to the higher pressure. Now, although it is possible for such motion to exist if the velocity in the cyclonic region exceeds a certain value, or, in the anticyclonic region, lies between certain limits, it is not possible to have steady motion of this type, and the effect of damping would be to make the motion from the higher to the lower pressure. The evidence points to the conclusion either (1) that cyclones and anticyclones arriving in the European area are in general dissipating systems which are continually replaced by other systems arriving from what may be called productive regions, or (2) that there is interchange of air with regions in which the surface temperature or the temperature gradient differs sufficiently to produce mean temperatures greater in low-pressure areas and less in high-pressure areas than are found over Europe.

It is interesting in connection with this part of the subject to note that Shaw and Lempfert deduced from a discussion of surface air currents that the central areas of anticyclones were not the regions of origin of currents, and could not, therefore, be places where descent of air was taking place to any considerable extent. The temperature observations in the first 3 km. agree with this conclusion, since they show that there is no approach to a regular adiabatic gradient near the centres of anticyclones.

Perhaps the most remarkable phenomenon revealed by the observations from registering balloons is the comparatively sudden cessation of the fall of temperature at a height which varies from day to day, but is roughly equal to 10 km. Above this height, which may be regarded as the height of an irregular, but roughly horizontal, surface dividing the atmosphere into two regions, the temperature at any time varies very little in a vertical direction, showing, on the average, a slight tendency to increase. The lower and upper regions are characterised by the terms "convective" and "advective" respectively, and the height and temperature of the dividing surface are denoted by H_c and T_c. The following table gives the values of H_c, T_c, for certain places in Europe:—

	Mean of 13 Stations	Munich	England	Strassburg	Paris	Pavlovsk	Koutchino	Milan	Vienna	Berlin
H_c	10·6	10·9	10·8	10·8	10·4	9·6	10·6	10·7	10·2	10·7
T_c	16°	16°	18°	15°	18°	18°	14°	17°	15°	16°
No. of cases ...	336	53	32	67	57	28	18	25	24	32
Latitude... ...	—	48°	52°	49°	49°	60°	56°	45°	48°	52°

There is very little variation for places between lat. 45° and lat. 55°, but at Pavlovsk H_c is about 1 km. below the average. Observations made in the equatorial regions show that the value of H_c there exceeds 15 km., so that there must be a considerable increase in its value in crossing the limit of the trade-wind region, and it appears probable that the equatorial currents and the trade winds form a closed system with little interchange of air with higher latitudes.

The annual variation in H_c, T_c is shown by the following table:—

Annual Variation in H_c.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean of 13 stations...	10·3	10·4	9·1	10·1	10·5	10·7	10·9	11·4	10·4	11·9	10·8	10·1
Number of cases ...	26	22	32	39	31	27	24	61	46	38	25	25
Munich	10·0	10·4	9·2	9·2	11·2	11·0	11·7	12·0	10·3	12·3	11·8	11·4
Number of cases ...	4	3	6	4	2	4	3	11	5	5	2	5
Strassburg...	10·5	10·6	9·4	9·4	10·6	10·9	10·8	12·3	[illegible]	11·9	11·0	[illegible]
Number of cases ...	5	5	5	5	4	5	4	9	8	6	6	[illegible]

Annual Variation in T_c.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean of 13 stations...	13	11	16	16	17	20	20	18	22	14	15	14
Munich	14	10	16	19	25	20	15	16	26	9	10	13
Strassburg...	11	10	16	20	17	17	21	15	23	13	12	10

The remarkable feature is the relatively high temperature and low value of H_c in March and September. This peculiarity and the fact that T_c is least near the equator suggest that the general nature of the process may be as follows. The cool air above the equator moves polewards, and in the natural course descends again to feed the trade winds. Owing to the irregularities of the earth's surface, the change of seasons and the very considerable difference between the northern and southern hemispheres, the process will be neither regular nor symmetrical. Consequently, the equatorial cold air will encroach on the advective region of temperate latitudes, and such encroachments will produce anticyclonic regions. The advective atmosphere would be reached there at a higher level, and initially at a lower temperature than in the average state, but the temperature would be gradually raised by absorption of thermal radiation to the normal value for that latitude.

The fact that H_c has minimum values in March and September, when equatorial temperatures are highest, appears at first to be contrary to this view; but the first effect of increased temperature will be to increase the strength of the trade winds, and as at the same time there is a transference of air across the equator to the southern hemisphere, a transference which can be made only through the upper return current, there will be a deficiency of descending air, and the equatorial cold air will encroach less than usual on the northern advective region. The reverse process would be expected to occur in September, but the autumnal transference of air to the northern hemisphere will be initially much more intense towards the great continental regions than to the Atlantic and European area, and it may well be that the equatorial current again encroaches less than usual on that region. It may be expected that the value of H_c in Asia and America will not show the September minimum.

The explanation of the discontinuity in the temperature gradient appears to be this. The fall of temperature is governed mainly by convection, and a necessary condition for convection to persist is that the radiation shall exceed the absorption in the upper layers of the convective system. A limit is therefore set to the height to which convection can extend, and at this limit the discontinuity in the fall of temperature occurs. It has been shown that the observed height is about the same as the limiting height of the convective system found from theoretical considerations based on the experimental knowledge of the radiating power of the atmosphere.

The results of the observations of wind velocity may be briefly summarised as follows. In general, the velocity increases with height, the greater part of the increase up to 2000 m. taking place in the layers immediately above the surface; 75 per cent. of the total increase takes place in the first 160 m. Above 500 m. numerous cases occur where the velocity decreases with height. The velocity for heights up to 10 km. is given approximately by the equation $V\rho = V_0\rho_0$ (Egnell's law), where V is velocity and ρ density, $V_0\rho_0$ being the values near the surface. The law implies that the pressure gradient remains constant and independent of the height. Now, owing to the fact that the temperature is higher over regions of high pressure than over regions of low pressure, the ratio of pressure gradient to density increases with height. The condition for a constant gradient up to 8 km. is approximately

$$t_0 = \frac{74\,\delta p}{p} \text{ degrees C.},$$

where t_0 is the excess of the mean temperature of the air-column at a place at pressure $p+\delta p$ above that at a place at pressure p. Observations show that for $\delta p = 20$ mm., $t_0 = 4°$ C. nearly, or double the amount necessary for constant gradient. It is to be expected, therefore, that $V\rho$ will increase up to 8 km., and the few pilot-balloon observations available point to such an increase.

The direction of the upper wind usually veers from that at the surface. The following table shows the deviations for winds from different quadrants in England and at Berlin:—

Deviation of the Upper Wind.

England.

Heights	0·5 km.	1·0 km.	1·5 km.	2·0 km.	2·5 km.	3·0 km.
W. ...	9°	14°	14·5°	14°	8°	8°
N. ...	4	8	3	−1	−3	−15
E. ...	15	22	20	28	35	21
S. ...	14	26	32	38	41	50

Berlin.

Heights	0·5 km.	1·0 km.	1·5 km.	2·0 km.	2·5 km.	3·0 km.
W. ...	18°	23°	23°	20°	23°	22°
N. ...	13	17	20	20	15	25
E. ...	27	30	38	45	46	44
S. ...	38	46	48	49	53	46

The deviation at Berlin is in nearly all cases greater than in England, especially for north winds, which back slightly in the upper air in England.

There is no marked difference between anticyclonic and cyclonic conditions in the change of wind velocity and direction with height. The following table gives the values deduced from observations at Berlin and Lindenberg in 1905:—

	Height	Surface	1 km.	2 km.
Anticyclonic (A)	Deviation ...	—	30°	33°
	Velocity	4·1	8·2	8·4 m.p.s.
	Ratio to surface velocity	1·0	2·0	2·05
Cyclonic (C)	Deviation ...	—	30°	37°
	Velocity	5·9	10·5	10·7
	Ratio to surface velocity	1·0	1·78	1·82

The deviation is slightly greater and the ratio slightly less in C than in A. It would be natural to suppose that surface friction and irregularities would produce a decrease in velocity which increased at a greater rate than the velocity itself, and in that case the ratio in C would be greater than in A, as was actually found by Berson from the manned balloon observations.

SOLAR VORTICES AND MAGNETIC FIELDS.[1]

II.

I HAVE already referred to the importance of applying in astronomical research the methods of the physicist. During the last quarter of a century the study of spectroscopic phenomena in the laboratory has been completely transformed. It may well be said that this transformation, which has involved such discoveries as spectral series, the effect of pressure on wave-length, and the Zeeman effect, has been directly due to the use of Rowland's concave gratings, of great focal length, arranged for photography. In astronomical spectroscopy great advances have also been made, but the spectroscope has continued to occupy the place it formerly held as an attachment of the telescope. Although Rowland used a long-focus concave grating for his classic study of the solar spectrum, the heliostat and lens employed with this instrument gave so small a solar image on the slit that the investigation of sun-spots and other details was impossible. We thus see that while in the observatory the spectroscope continued to be used as an accessory of the telescope, in the laboratory the parts were exchanged and the telescope was employed simply as an accessory of the spectroscope. It seemed obvious that a great opportunity for advance lay open to the investigator who would combine a long-focus spectroscope with a long-focus telescope. As it would be difficult, or perhaps impossible, to use for photography a sufficiently long spectroscope attached to the tube of an equatorially mounted telescope, some form of fixed telescope was plainly essential.

The tower telescope on Mount Wilson (Fig. 5) is designed to accomplish this purpose. It consists essentially of a 12-inch refracting telescope, of 60-feet focal length, mounted in a fixed position, pointed directly at the zenith. The ordinary telescope tube is replaced in this case by a light steel tower, firmly held in position by steel guy ropes. The 12-inch objective lies horizontally at the summit of the tower, and sunlight is reflected into it from the second of two adjustable plane mirrors. The first of these mirrors is mounted as a cœlostat, and is rotated by an accurate driving-clock about a polar axis at such a rate as to counteract the apparent motion of the sun. Thus a beam of sunlight is reflected from the cœlostat mirror to the second mirror, which sends it vertically downward through the objective. In the focal plane, 60 feet below the objective, an image of the sun, about 6·6 inches in diameter, is formed on the slit of a spectrograph, at a height of about 3 feet above the surface of the ground. After passing through the slit, the light of any desired portion of the solar image (a sun-spot, for example) descends vertically into a well about 30 feet deep excavated in the earth beneath the tower. Thirty feet from the slit the diverging rays encounter a 6-inch objective, through which they pass. After being rendered parallel by the objective, the rays fall upon a Rowland plane grating, ruled with 14,438 lines to the inch. The grating breaks up the light into a series of spectra, and the rays are returned through the same objective, which brings the spectra to a focus at a point near the slit. By inclining the grating at a small angle, the image of the spectrum is made to fall at a point slightly to one side of the slit, and here the photographic plate is placed. Thus a portion of the spectrum 17 inches in length can be photographed in a single operation. In the work on sun-spots, most of the photographs are taken in the third order of the grating, where the dispersion and resolving power are very high. When the spot spectrum is being photographed, only the light from the umbra is admitted to the slit. At the end of the exposure this portion of the slit is covered, and light from the photosphere, at a point removed from the spot, is admitted to the slit on either side. Thus the narrow spot spectrum is photographed between two strips of solar spectrum, used for comparison.

The advantages of this combined form of telescope and spectrograph are considerable. On account of the great thickness (12 inches) of the mirrors, the height of the cœlostat above the heated earth, and the use of a vertical beam, the definition of the solar image is always better than with the Snow (horizontal) telescope. Another important advantage is the nearly constant temperature at the bottom of the well, where the grating is placed. This permits long exposures to be given, when necessary, without danger of such displacements of the spectral lines as would be caused by expansion or contraction of the grating. The grating used in this spectrograph is a small one, which I have employed in most of my work since 1889, but the unusual focal length of the spectrograph permits the full visual resolution of the grating to be utilised in photographic observations. Thus it has become possible to photograph the widened lines and doublets, as well as a host of narrow lines, most of them due to chemical compounds, which had not previously been recorded in the spot spectrum.

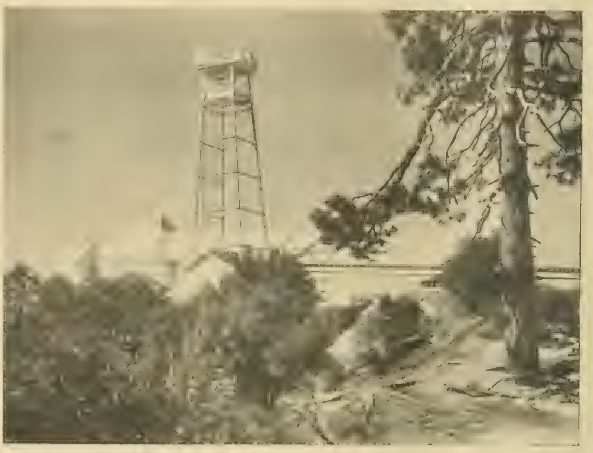

FIG. 5.—Tower Telescope on Mount Wilson.

Lack of time prevents me from discussing in this lecture the various studies of sun-spot lines carried out with this instrument before the attempt to detect a magnetic field in spots was undertaken. An extensive catalogue of these lines is nearly complete, a preliminary map has been issued and a better one is in preparation, and a series of investigations with the arc and electric furnace has suggested that the strengthening and weakening of certain lines is due to a reduction in the temperature of the spot vapours. At present we are concerned with the cause of the widening and doubling of spot lines, and the method of testing this question must now be described.

A Nicol prism was mounted above the slit of the spectrograph, and just above this a Fresnel rhomb. If the components of a spot doublet were circularly polarised in opposite directions, passage through the rhomb should give two plane polarised beams, the planes of polarisation making an angle of 90° with each other. Thus in one position of the Nicol one of the components should be photographed alone, and by turning the Nicol 90° this should disappear and the other component come into view.

When this test was applied with the tower telescope, in June, 1908, the true character of the spot doublets became apparent (Fig. 6). One or the other component of the doublet could be cut off at will by rotating the Nicol, precisely as Zeeman had done in the laboratory. On account of the unique character of the Zeeman doublets, this test alone was almost sufficient to prove the existence of a magnetic field in sun-spots. But one of the great beauties of the Zeeman effect is its many-sided character, which permitted the test to be multiplied and extended. From Zeeman's first experiments it was known, for example, that if the strength of the magnetic field is insufficient to separate completely the components of a doublet, the edges of the resulting widened line should be circularly polarised in opposite directions. Thus those lines which are widened, but not doubled, in spots might be expected to shift in position when the Nicol is rotated. This was found to be the case. Again, the lines which constitute the flutings of the spectra of compounds are not, in general, affected by a magnetic field. Hence such lines in the spectrum of a sun-spot should not be shifted when the Nicol is rotated. This, also, was found to be true. But a still more satisfactory test was suggested by another laboratory phenomenon. When a doublet is observed along the lines of force, with one of the components extinguished by the Nicol, reversal of the current through the magnet should extinguish the visible component and cause the invisible one to appear. In the sun, according to our hypothesis, reversal of the direction of revolution in a vortex should correspond to reversal of the current through the coils of a magnet. Hence the red component of a doublet should appear in the spectrum of a vortex rotating in one direction, the violet component in that of a vortex rotating in the reverse direction. Fortunately, the appearance, on opposite sides of the solar equator, of two spot vortices rotating in opposite directions (Fig. 4) made this test possible. The results were perfectly in accord with the hypothesis.

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[1] Discourse delivered at the Royal Institution on Friday, May 14, by Prof. George E. Hale, For.Mem.R.S. Continued from p. 23.

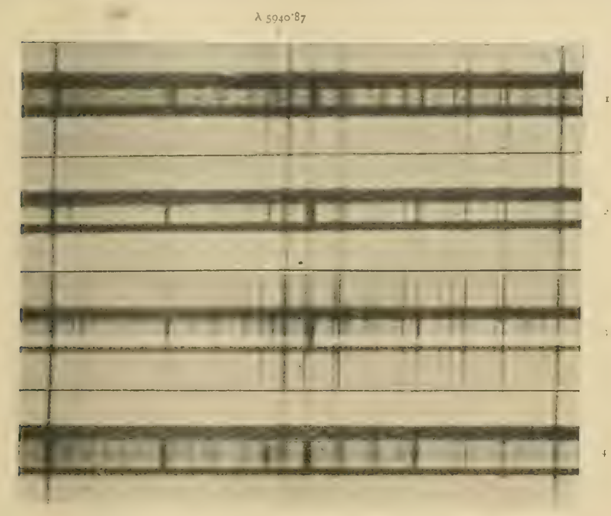

Fig. 6—(1) Southern Spot, showing Red Components of Doublets. Nicol, 29° W. (2) Northern Spot, showing Violet Components of Doublets. Nicol, 29° W. (3) Northern Spot, showing Red Components of Doublets. Nicol, 61° E. (4) Spot Spectrum without Rhomb or Nicol, showing both Components of Doublets.

So far we have been considering only such phenomena as are observed parallel to the lines of force of a magnetic field; but a spectral line which, in such circumstances, appears as a doublet is usually transformed into a triplet when the observation is made at right angles to the lines of force. The circularly polarised side components of the doublet give place to plane polarised components, occupying the same position, while another line appears centrally between them. The light of this line is also plane polarised, the direction of the vibrations being parallel to the field, while the vibrations of the side components are in a plane at right angles to the field. Thus when a spot is carried by the solar rotation to a point near the limb we might expect the double lines in its spectrum to be transformed into triplets if produced by a magnetic field. The failure of the central line to appear seemed to raise an important argument against the magnetic hypothesis.

At this point the necessity of conducting laboratory investigations in immediate conjunction with astronomical observations is well illustrated. Fortunately, our laboratory was already well equipped for work of this nature (Fig. 7). In anticipation of the possibility that observations of the Zeeman effect would be needed in the interpretation of solar and stellar phenomena, a powerful electromagnet, with suitable accessory apparatus, had been provided. A brilliant spark, produced between metallic electrodes in the field of the magnet, furnished the source of light. As many of the double lines in sun-spot spectra are due to iron, this metal was selected for the first experiments. The spectrum was photographed, at various angles with the lines of force, with a powerful spectrograph, like the one used with the tower telescope, similarly mounted in an underground chamber.

The difficulty of accounting for the behaviour of the iron doublets in the sun was removed by these investigations. It appears that these lines do not become triplets when observed across the lines of force. In reality they are changed to quadruplets, or doublets in which each of the components is a close double line. In the magnetic field of sun-spots, which is much weaker than the field used in the laboratory, the closely adjoining lines which constitute the components of the doublets cannot be separated. Thus these sun-spot lines should appear double at whatever position the spot may occupy on the sun's surface.

The distance between the components of doublets or triplets separated in the magnetic field varies greatly for different lines. Some exceptional lines are not affected in the least, others are merely widened, and others are clearly and sometimes greatly separated. It is therefore important to compare the widening and the separation of lines in a sun-spot spectrum with the corresponding phenomena in the magnetic field. With few exceptions, most of which may be accounted for by the presence in the spot spectrum of closely adjoining lines of other elements, the solar and laboratory results were found to be in good agreement. The following table gives a comparison of certain iron lines in the spot and laboratory :—

Wave-length	Δλ, spark	$\frac{\Delta\lambda, \text{spark}}{5\cdot1}$	Δλ, spot	
6213·14	0·703	0·138	0·136	−0·002
6301·72	0·737	0·144	0·138	−0·006
6302·71	1·230	0·241	0·252	+0·011
6337·05	0·895	0·175	0·172	−0·003

The column headed "Δλ, Spark" gives the distance between the components of the lines as observed in the laboratory. As the strength of the magnetic field used in the laboratory was about 5·1 times that of the spot, the quantities obtained by dividing the separations in the second column by 5·1 are given in the third column. These separations are directly comparable with the separations of the corresponding lines in the spot, which are given in the fourth column. The fifth column shows that the differences between the solar and laboratory results are very small. As the strength of the field in the laboratory was about 15,000 gausses, the strength of the field in this spot would be about 15,000÷5·1=2900 gausses. The strongest field hitherto measured on our photographs of spot spectra is about 4500 gausses, corresponding to a considerably greater separation of the lines (Fig. 8).

When a similar comparison was made for various lines of titanium and chromium, a much less perfect agreement between the spot and laboratory results was found. It had already been observed that such lines as D of sodium and *b* of magnesium, which undoubtedly represent a much higher level than the great majority of lines in the spot spectrum, are but very slightly widened. As these lines are strongly affected by a magnetic field in the laboratory, it appeared evident that the strength of the field in spots must fall off rapidly in passing outward through the spot vapours. In these circumstances lines of other elements, which represent levels higher than the average, should show small separations in the magnetic field of the spot. It seems probable that in this way the lack of perfect agreement between the laboratory and solar results observed in the case of titanium and chromium can be accounted for.

A further important test was afforded by the well-known phenomenon exemplified in Preston's law. According to this law, the distance between the components of the lines split up by a magnetic field varies directly as the square of the wave-length. This we found to be true even in the case of a metal like iron, the lines of which cannot be grouped into series, if the average separations of a sufficient number of lines were considered. We should therefore expect that the widening of lines in spots would rapidly decrease toward the violet, and that the separation of spot doublets should diminish in a similar way. A study of the spot spectrum shows that this actually occurs.

It soon appeared that the normal spot spectrum always contains triplets as well as doublets (Fig. 8). These are less easily recognised, because the presence of the central line crowds the components so closely together that they are not readily separated with the resolving power available. As these triplets are photographed even when the spot is very near the middle of the sun, it is evident that the spot always sends out light which makes a considerable angle with the lines of force. In a normal triplet the central line is of twice the intensity of the side components, when observed at right angles to the lines of force, and disappears altogether when observed parallel to the lines of force. Thus, by determining the relative intensities of the central and side lines of such a triplet, the angle between the lines of force and the line of vision can be obtained. In the case of sun-spots, the data at present available are not sufficient for the accurate determination of this angle, but it seems to lie between 30° and 60° when the spot is near the centre of the sun. On the hypothesis that the magnetic field is produced by the spot vortex, it would then follow that the axis of the vortex, instead of being radial, as we at first assumed, makes an angle of much less than 90° with the surface of the photosphere.

The time at my disposal permits me to describe briefly only a few other phases of this investigation. In the laboratory the central line of triplets is polarised in a plane parallel to the magnetic field. Hence, if the light is passed through a Nicol prism, used without a rhomb, it should be possible to extinguish this line at certain positions of the Nicol, in which case a spot triplet would appear as a doublet. This test has also been applied to the spot triplets, with the expected result. In fact, this method supplies a convenient means of recognising close triplets, the components of which are too closely crowded to be seen separately before the central line is cut out. Indications have also been obtained of what may prove to be unequal rotation of the plane of polarisation of this central line in different parts of spots. The gradual decrease in the strength of the field from the umbra to the outer limit of the penumbra has been studied, and magnetic fields have been detected on the sun's disc, in certain regions outside of sun-spots. It is evident that many new phases of the subject are likely to be developed in the future, especially if larger images of the sun and more powerful spectrographs are employed. In this connection it may be stated that a tower telescope of 150-feet focal length, to be used on Mount Wilson with a spectrograph of 75-feet focal length, is now under construction.

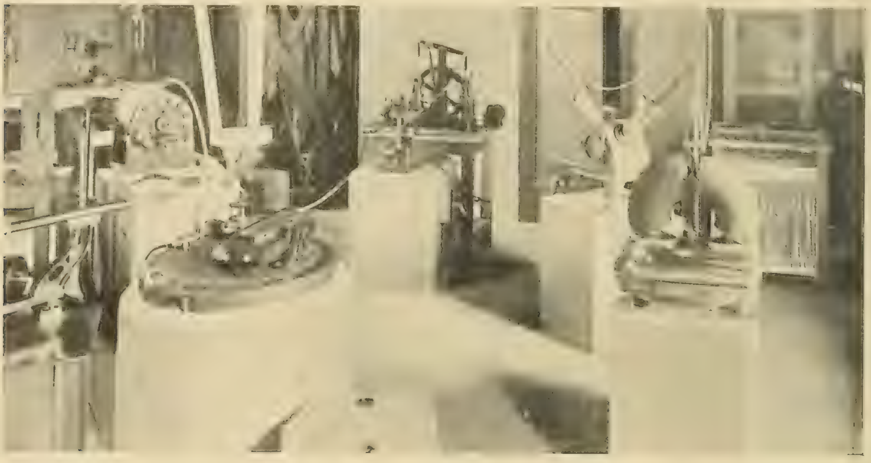

FIG. 7.—Interior of Pasadena Laboratory, showing Slit-end of Vertical Spectrograph and Magnet used in study of Zeeman effect.

This will give a focal image of the sun about 16 inches in diameter, in which small spots, as well as large ones, can be studied.

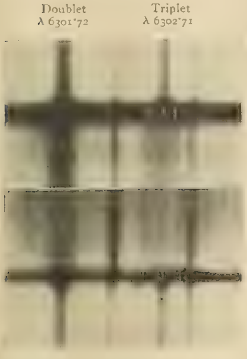

FIG. 8.—Iron Doublet (λ 6301·72) and Triplet (λ 6302·71) in Two Spot Spectra, showing Field Strengths of 2900 and 4500 Gausses respectively.

Although it now seems to be demonstrated that sun-spots are electric vortices, judgment should be reserved as to the various theories which have been advanced to account for their origin. Many of the results I have described appear favourable to Emden's solar theory, but it seems to be opposed by the important investigations of Evershed, who has found that the metallic vapours in sun-spots flow radially outward from the umbra, parallel to the photosphere. The further development of Evershed's work, and the continued study of solar vortices and magnetic fields, should soon permit a trustworthy theory of sun-spots to be formulated.

It is evident that the rapid decrease upward of the strength of the field in spots would prevent this field from having an appreciable influence on the higher solar atmosphere. At the distance of the earth, as Schuster has shown, the combined magnetic effect of several spots, all assumed to be of the same polarity, and having no such rapid decrease in field strength at higher levels as is actually observed, would be altogether incompetent to account for terrestrial magnetic storms.

In concluding, I wish to express my appreciation of the assistance I have received from my colleagues at Mount Wilson. I am particularly indebted to Messrs. Adams, Ellerman, King, Nichols, and St. John for aid in connection with the present investigation.

THE NEW ROOMS OF THE ROYAL SOCIETY OF EDINBURGH.

ON Monday, November 8, the new rooms of the Royal Society of Edinburgh were formally opened by an appropriate inaugural address from the president, Sir William Turner, followed by a brilliant reception. For the purposes of the reception the ordinary meeting-room was transformed into the cloak-room, and the president's address was delivered in the Freemasons' Hall, a few blocks further west in George Street. After the address the audience re-assembled in the society's new abode, and had every opportunity of inspecting the arrangements which had been made for the accommodation of the large and growing library and for other possessions of the society.

The important events which led up to the migration of the society from its historic haunts in the beautiful building in Princes Street were described by the president in his address. The National Galleries of Scotland Bill, introduced into the House of Commons in 1906, provided that the Royal Institution, so long the home of the society, should form a part of the National Gallery of Scotland and be applied to the promotion of the Fine Arts. As the result of representations made by the society, a clause was introduced into the Bill by which the Treasury was empowered to provide funds both for the purchase and equipment of a new habitation for the society, and for an annual grant of 600*l.* to assist in the discharge of the scientific work. The natural feeling of regret at having had to give up one of the finest sites to be found in any city of the world is partly balanced by the knowledge that now the society has, for the first time in forty or fifty years, ample accommodation for its valuable library.

When the building now occupied by the society was vacated two years ago by the Edinburgh Life Assurance Company, operations were at once begun by the Board of Works to fit it for its new function. No structural changes of magnitude were needed to make the rooms effective for their purpose. The late librarian, Mr. Hardy, whose lamented death last spring deprived the society of a singularly efficient and devoted officer, had meanwhile been planning the whole arrangements of the library, and what is now seen is largely the result of his forethought and attention to details.

The building is entered by two doors. The east door is open daily, and through it entrance is at once gained to the front saloon, where there is every convenience for reading and writing. The west door is opened only on meeting days. It leads directly into a staircase, by which immediate ingress is gained to the meeting-room, which is fitted with a lecture table and appliances of various kinds. By the same staircase, also, access is had to the reception room on the first floor and to various library rooms on the second floor.

The guests on the night of the reception passed up the west staircase, at the first turn of which a fine bust of Cuvier greeted them with calm dignity.

Along the walls of the meeting-room (transformed for the occasion into the cloak-room) some other interesting busts are to be seen—Berzelius, John Playfair, Rev. Sir H. Moncrieff Wellwood, and Sir Walter Scott; also an engraving of the statue of Sir Joseph Banks in the British Museum, executed by Chantrey. A photograph of Sir Richard Griffith and an engraving of D. Milne Horne also decorate the walls.

Passing out of the meeting-room and up a few steps we come to the ante-room, with oil portraits of James Watt and William Murdock, one of the pioneers of gas lighting. In the handsome reception-room immediately adjoining are portraits of former well-known presidents and secretaries—Sir T. Makdougall Brisbane, Sir James Hall, Profs. J. D. Forbes and John Robison, the last a Raeburn; also a bust of Sir Roderick Murchison occupies one corner. Passing across the reception-room we emerge at the head of the east staircase, which leads down to the front saloon and to the east door. The portraits which decorate the walls of this fine staircase are (beginning from the top) those of Piazzi Smyth, Patrick Neill, Sir David Brewster, Sir Robert Christison, Sir Walter Scott, and the first president, Henry, Duke of Buccleuch. In addition to these there are several good engravings of portraits of Henry Mackenzie (the "Man of Feeling"), the Right Hon. Jas. Moncrieff, and Dr. William Robertson, the historian (a fine engraving by J. Dixon from the portrait by Sir Joshua Reynolds).

The front saloon has its walls covered with books, and contains a life-like bust of James Gordon, the late librarian. Opening off it at the north-west corner is the librarian's room or office, with a portrait of Sir Humphry Davy over the mantelpiece. Adjoining it is the council-room, with the well-known portrait of Prof. Tait (by Sir George Reid) hanging above the fireplace, and on each side a drawing of the birthplace of Sir Isaac Newton, presented to the society by a son of Prof. Robison. The same donor also gave a small carved door, which formed part of a book-press belonging to Newton. Passing out of the council-room by a door in front of the foot of the east staircase, and turning along a passage to the right, we come to a large oblong room called the back saloon. Round the walls are steel book-cases filled with the Transactions and Proceedings of various scientific societies of foreign countries. The countries are arranged alphabetically, and under each country the towns are similarly arranged, so that a visitor has not the least difficulty in finding the shelves on which the publications of any given society are placed.

Near the council-room door a staircase leads down to the basement, where, in addition to rooms set apart for shelving books, are strong-rooms for storing the society's own Transactions and Proceedings, and the blocks and plates of illustrations. These are all admirably arranged, so that the stock in hand can be estimated almost at a glance.

Taking a general survey of the contents of the many book-cases which line the walls of the various rooms, we soon recognise the guiding principle of the whole. The front saloon or reading-room contains such journals and periodicals of a general scientific character as are most in demand. The librarian's room contains mathematical journals, the society's own publications, and the various scientific catalogues and dictionaries. In the council-room the reports of scientific expeditions find a place, and the quarto volumes of the American and Indian Geological Surveys, and much of a connected nature. The back saloon has already been described. In the basement we find journals of zoology, botany and medicine, electrical engineering, meteorology, geodesy, geology, &c.

There are no book-cases in the meeting-room or reception-room, but on the second floor there are three fairly large rooms and one small room filled with books. In one we find periodicals and books bearing on geography, biography, philosophy, philology, in another astronomy, and in a third the literary weeklies, monthlies, and quarterlies.

This description is not, of course, exhaustive, for, besides the periodical publications, the Royal Society of Edinburgh possesses many books of historic value and antiquarian interest; also the complete works of famous men of science from Galileo down the centuries. It will serve, however, to show that, as regards the accessibility to their literary treasures, the society has distinctly benefitted by their change of location.

The reception-room on the first floor, where the fellows meet for tea and talk before the afternoon meetings and after the evening meetings, has been beautifully designed, largely under the advice of Sir George Reid.

The least satisfactory of all the arrangements is the meeting-room for the reading of papers, but it is difficult to see how anything better could have been done. The lecture table, with gas fittings, occupies part of one of the long sides. The lantern-screen partly covers the black boards on the wall behind, the lantern being ensconced in a niche in the opposite wall. The hangings and decorative busts have practically killed the echo which was heard when the room was first tried. Yet to the many fellows who remember what used to be, the present arrangement lacks a certain undefinable flavour of old-world dignity. There is too much of the modern lecture-room and too little of the feeling of a scientific and literary society met for the interchange of views.

In other respects, however, the society has gained much by its removal from the limited space at its disposal in the Royal Institution to the spacious accommodation in George Street. Its remarkable collection of portraits and busts can now be seen to advantage, and the ready accessibility to its valuable library of books and periodical literature in all departments of science and in many departments of philosophy and art cannot but confer a great boon to the fellows and others engaged in research work.

The reception on Monday night was a large gathering, representing all phases of national life, such as Parliament, the Church, the Bench and the Bar, other legal bodies, the Scottish universities and leading educational institutions, the Royal Academy, municipalities, parish councils, &c.

THE INTERNATIONAL INVESTIGATIONS IN THE NORTH SEA AND THE SCOTTISH BOARD'S ANNUAL REPORT.[1]

SIX years have now elapsed since the commencement of the international fisheries' work by the seven nations concerned, and with the bulky literature and masses of tables and plates in hand it may be thought that now a stage has been reached which will demonstrate one way or another the position of the sea-fisheries, especially as it was stated that results of importance were early to be forthcoming. Yet in scanning the various publications no very definite general conclusions are apparent, and the question of primary importance to this country remains—excepting the statistics of the bureau—as far from solution as ever. To take the publications in the order abovementioned, the first is Dr. Kyle's important statistics of the North Sea fisheries for 1906. So far as can be observed, the total of the sea-fisheries of each nation shows an increase both in quantity and value on the previous year (1905), with the exception of Ireland. In the case of such fishes as the cod and the haddock, the ever-recurring variability displays itself in an increase of both in Denmark and the Netherlands, a diminution in Germany, an increase of cod and a diminution of haddock in Belgium, an increase of cod in Sweden, and a great increase of the same fish in England and in Scotland. Along with this is a considerable diminution of plaice in Sweden, England, and Belgium, and a considerable increase in Scotland and the Netherlands, a great increase in Denmark, and a nearly stationary condition in Germany. Dr. Kyle points out, however, that this decrease is due to a diminished capture of the smaller sizes of plaice (*e.g.* in England, Holland, Germany, and Belgium). Much has been written about the decrease of the lemon-dab (or so-called "lemon sole") in Scottish waters, yet in 1908 it brought 70,134*l.*, or 1400*l.* more than in the previous year. In the same way, whilst the sole and the turbot vary in the different nations, the dab remains stationary in Scotland, where it was supposed by its increase to be ousting the plaice. These statistics, which cover a much wider area than it is possible to allude to here, are perhaps the most important result of the international scheme, and they show how uncertain and variable sea-fishing is. Moreover, they demonstrate that whilst in one country the capture of a species may temporarily be diminished, in another it is increased. The comparative constancy of the totals and the large amount of fluctuation in individual species are points emphasised by Dr. Kyle. Further, no Continental nation approaches the share taken by Britain in this industry, England having 39 per cent. and Scotland 34 per cent. as their respective shares, the nearest being Holland with 12 per cent., Germany having only 4·7 per cent.

The report of the International Council between July, 1907, and July, 1908, is chiefly occupied with the record of changes in the *personnel* and an epitome of the seventh annual meeting at Copenhagen. It is noteworthy that the council is still in want of information concerning important fishes, such as the plaice, flounder, and other flat fishes, the haddock and other gadoids, and the herring and mackerel of the North Sea. Anything like finality in its labours seems as far distant as ever, yet hydrographical and "plankton" work still hold it. Prof. Garstang, moreover, gives an interesting account of the distribution of the plaice in the North Sea, Skagerak, and Kattegat according to size, age, and frequency, no fewer than 2048 hauls of the trawl and 327,000 examples of plaice having been dealt with; yet the decline in the returns from Sweden and Belgium after 1904, and from Scotland after 1905, must seriously affect the scope of the results. In regard to general distribution, the facts corroborate those elicited in 1884,[1] viz., the occurrence of small plaice in shallow water and of large in the deeper water, with a constant interchange between the two areas. Yet it is impossible to establish a hard-and-fast correlation between the size of the plaice and depth. The very general distribution of this species over the North Sea is a further guarantee for its safety. Mention is made of "dense" accumulations of plaice in the "protected Scottish Firths," but such accumulations were there before protection existed. It is stated that from fifteen to twenty plaice of 35 cm. were caught per hour in the inner part of St. Andrews Bay, information which will cheer the fishermen there, since for thirty years at least the uniform sizes caught for sale have been from 10 inches to 13 inches. The idea that many large plaice leave the Firth of Forth and enter St. Andrews Bay during the autumn, thereafter proceeding to deeper water to spawn, and again swell the ranks in the Forth, is in need of confirmation. Similar remarks apply to the changes noted in the large plaice of the Moray Firth. Minimum captures on the inner areas or outer "deeps" are not necessarily connected with "migrations." The remarkable oscillations described as occurring in the small plaice of the eastern area of the North Sea, viz. that they pass outward and again "work their way backward" inshore, would have been less phenomenal and would not have required the aid of "hibernation" if researches on the same size on the western shores (British) had been systematically carried out, along with an inquiry into the early post-pelagic and subsequent stages below the sizes selected. Migrations, indeed, loom largely in the international work, even to the supposition that the cat-fish (Anarrhichas) is as regularly migratory in the spring as the hake is in autumn. Moreover, large plaice were common in the Moray Firth before its closure, and are still there, the smaller finding ample scope in the shallows and the larger sufficient depth within the area. In regard to seasonal changes in the stock of plaice, it has long been known that captures in mild weather are greater, and that a cold, frosty morning diminishes them, but it does not follow that such captures give trustworthy information as to "maximum and minimum densities." The changes on the various "banks" naturally follow the spreading of the younger plaice seawards, but "hibernation" of small plaice and immigration of large, mature fishes rest largely on conjecture, as does also the notion, marking notwithstanding, that large numbers of mature fishes "migrate from the north for spawning purposes." The supposed scarcity of large plaice in the deeper water in winter may be due to other causes than migration, though congregation for spawning purposes is reasonable. Mr. Hefford's paper on the proportionate distribution of the sexes of plaice in the North Sea does credit to his ability, but his conclusions would need the support of longer experience, especially as a large inner area, viz. from Montrose to Kinnaird Head, has been omitted. The notion that the proportion of sexes of plaice may yet indicate the intensity of trawling in a given region is scarcely warranted.

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[1] Conseil permanent international pour l'Exploration de la Mer.

Bulletin statistique des Pêches maritimes des Pays du Nord de l'Europe, vol. iii. pour l'Année 1906. Pp. 83. (Copenhagen: A. F. Host and Fils, 1909.)

Rapports et Procès-verbaux des Réunions, vol xi., Juillet, 1907–Juillet, 1908. Pp. xxv+176+51. (Same publishers, 1909.)

Rapports, &c., vol x., Rapport sur les Travaux de la Commission dans la Période 1902–7. (Same publishers, 1909.)

Twenty-seventh Annual Report of the Fishery Board for Scotland for the Year 1908. Part i., General Report. (Edinburgh: Oliver and Boyd.)

[1] Scientific Trawling Report, pp. 21, 25, 43, 76, &c., 1884, and in General Report, 1885, correspondingly.

Vol. x. consists of a bulky report dealing with the whole period (1902–7). It reiterates the problems to be solved and the methods followed by the administrative committee, with a summary of the results, besides a series of special reports by seven responsible authors. Some of these reports have previously been published, and have received attention elsewhere, so that they need not be alluded to. In the summary of the results the administrative body deals first with the depths and hydrography of the oceanic regions investigated. Then the spawning conditions and spawning places of the gadoids (seventeen in number) are considered, and it is to be noted that the investigation of both is now held to be complete, a view some may doubt, considering the scattered cruises of the steamers, and when on the next page it is stated that the spawning places cannot always be given with absolute certainty. The summary is full of interest, but in the case of several species the limitations given by the committee need re-investigation, and, for instance, no differentiation of the areas of the British coast has been attempted as regards the cod. The third head treats of the "natural conditions in the spawning regions," and an effort is made to connect temperature and salinity with the spawning process. The gadoids, however, are not the only fishes in these waters, and there is perhaps little more in the matter than that an Arctic, a temperate, and a tropical fish finds—each in its own waters—the most suitable spawning conditions. Besides, the refinements of temperatures and salinities, however interesting scientifically, count for little in the main question put before the investigators by the British Government. It was well known that wherever the conditions of life were suitable, there the pelagic larvæ and young fishes were found with great regularity, irrespective of currents, temperatures, and salinities. No current is known which will take the larval cod with unfailing regularity in one direction and the haddock in another, which will keep the larval dabs and top-knots often in deeper water whilst the plaice is with unfailing accuracy sent to the margin of the beach. No currents, temperatures, or salinities will explain why in 1908 the herring fishing was very successful in the northern Scotch area and less successful in the southern, and why in 1909 exactly the reverse was the case. In this connection, Schmidt also gives no reason why the ova and fry of *Gadus luscus* are not carried far from their spawning place. What can those familiar with the subject make of the following:—"According to the spawning time, first the cod eggs, then the haddock eggs, and lastly the whiting eggs are involved in the movement of the currents"? It has not been shown that the currents which distribute the eggs of the pollack and the poor cod in the Atlantic in spring have their equivalents in the summer when the same fishes spawn in the North Sea, though there is little fear as to the safety and distribution of the eggs of these and all other marine fishes. The guarded remarks of the committee are therefore warranted, viz. "the investigations we are discussing here are far from being able to solve so great a problem." Especially does this apply to the notion that all the young green cod which swarm on the Scottish coasts have been spawned on the North Sea bank, and that the cod makes long migrations for the purpose of spawning.

On the important problem of sea-fish hatching the committee make very cautious remarks, basing their views mainly on Knut Dahl's paper. In this it is shown that in small Norwegian fjords where cod spawn the captures by tow-nets were not influenced to any extent by the addition of thirty millions, and that the captures varied much in different years. No difference also was noticed in the quantitative occurrence of young littoral fishes each year. They found no proof of an increase of local stock by artificial hatching, but they do not discourage further experiments. The foregoing is in marked contrast with the results of Fulton in the upper waters of Loch Fyne, where shore-fishing with a push-net found an increase of young plaice during the six years in which 141 millions of young plaice were added, as compared with the following six, in which none were added. Yet in glancing at his figures it would appear that in four of the years in which none were added the average captures per hour compare favourably with those in which millions were put in, and, further, that a fifth year is second highest on the list even of the favoured years. The chances of error in work carried out in the circumstances, and the great variation from eight to 112 per hour when no addition was made, combine with other points to render this experiment in need of confirmation.

Seventy pages are devoted by the administrative body to the distribution, growth, and migrations of the older stages of the important food-fishes, and to some practical fisheries questions in the light of the results obtained. Under the former head the cod, haddock, and whiting alone are dealt with, the ages being determined by measurements by Helland Hansen, who finds little variation in the numbers of large and extra large haddocks during the years of investigation, and by the rings on the scales by Damas, whose prolix paper might well have been abbreviated. The reliance on the catches, for instance, of the haddock, in the deeper water of the North Sea as proving migration is open to question, and the remark by the administrative body that the reporters are not warranted in explaining the "marked" seasonal migrations, some of which are connected with the occurrence of shoals of herring, is safe.

One of the most interesting and important contributions is that of Johs. Schmidt, on the distribution of the pelagic fry of the gadoids and the spawning regions of the gadoids in the North Atlantic from Iceland to Spain. He lays, however, too much stress on his experiences of Icelandic currents in treating the conditions in the North Sea, and shows too evident a tendency to make out a case for the hydrographer.

Of the Scottish Board's report, it need only be said that it proves the prosperous condition of the Scottish fisheries, for though the total does not reach that of the previous year (1907), yet the deficit is due solely to herrings, the "catch" of other fishes being greater in 1908 than in 1907. It is a decade since the ruin of the lemon-dab ("lemon sole" of the Board) was in sight, yet the "catch" of this fish exceeded by almost 1200 cwt. that of 1907, when the record did not vary much from the preceding years. It is sometimes forgotten that the amount of flat fishes rises or falls according to the amount of energy expended in their capture, not because any noteworthy change has occurred in their numbers.

To sum up the international work, then, it would seem that considerable waste of energy and funds is caused by the re-publication of papers, and by the manner in which several of these overlap. Moreover, it is beyond the scope of science to enter into a disquisition on the fluctuations of the market-price of fishes. It is also noteworthy to find that, after seven years' work, the council now see the magnitude of their task and the absence of finality in their labours. There is no sign of "impoverishment"; on the contrary, their cautious words lean to the opposite view. The committee recommend continuation of their labours, basing this on the fact that various nations share in the North Sea fishing, and that no action could be taken without the consent of the other countries; but as to any important result to be gained by the fisheries there is silence, for it cannot be supposed that hydrography, the collection of fish-food and bottom deposits, can do duty any longer as necessary measures for the welfare of the North Sea fisheries.

W. C. M.

THE ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

AT the fifth annual meeting of the Association of Teachers in Technical Institutions, held on Saturday, November 6, Mr. J. Wilson, of the Battersea Polytechnic, president of the association, in moving the adoption of the annual report, reviewed the year's work. In the course of it he laid special stress upon the very important step taken by the association, at its conference at Liverpool, in putting forward a definite series of resolutions relating to educational reforms which appear to them as teachers to be essential to the continued progress of technical education. In these resolutions the association expresses its opinion that it is necessary to raise the school-leaving age to fifteen years; it asks that special attention be given to the teaching, in primary schools, of elementary science, practical arithmetic, and manual training; it calls for complete coordination of the work of the evening continuation schools with that of the evening technical schools; it asks for the provision of technical-secondary schools, including trade schools, with a generous system of scholarships, including allowance for maintenance; and, finally, it endorses the recommendations of the Minority Report of the Poor Law Commissioners respecting compulsory attendance of boys for technical instruction for not less than thirty hours per week. Thus a very definite policy in some important educational problems affecting technical education has been taken up by this association.

Another important, and in this case non-controversial, action is now being broached by this body of teachers. It suggests the desirability of holding a series of "round table" conferences between accredited representatives of primary, secondary, and technical teachers, with the object of discussing the possibility of reforms in the curricula and methods of work in the schools, from the point of view of the needs of the pupils who at a later stage pass on to the technical schools. Most urgent is the necessity for such conferences in the case of the primary and technical teachers, in order that they may arrive at a mutual understanding of the needs of the pupils and the possibility of meeting them, because in the majority of cases where pupils receive any formal teaching after the primary-school work, it is to the technical teachers that they come for it. Such conferences abound with immense possibilities for the benefit of education in all its phases. Broader and more complete knowledge of each other's branch of work and its needs and possibilities must necessarily result, and as a consequence many apparent difficulties in the way of making the educational work in the two or three types of school truly continuous, without unnecessary overlapping, will be removed. The better knowledge of each other's work will remove some prejudices and bring about the necessary unanimity of action in those matters which affect the teachers individually and as a class, such as conditions of service, security of tenure, and superannuation for all classes of teachers; these views being held by the association, it is all but unnecessary to point out to any other class of teachers, who have the duty, responsibility, and honour of teaching the pupils in their earlier years, that criticisms made by this association on the preparation of those pupils for later technical studies is not directed at the teachers, but at the systems imposed upon them, in which ideas, good in themselves, are allowed such sway as to mask the greater essentials of elementary-school work.

In 1888 Parliament passed a Technical Education Act, and for the past twenty-one years progress has been vigorous and rapid. Nevertheless, technical education has touched only a very small fraction of the enormous mass of material represented by the workers of all grades in the industries of the country. We can only regard it as having entered upon its duties, and must look forward to dealing with much larger numbers of students and to a greater range of work. There are two chief factors which may assist in bringing in much larger numbers of the young workers. The first of these is the increasing interest and help of the employers. Efforts in this field have so far produced but scanty results, and the association as a body is not very hopeful of this field. The second factor, to which the association looks with greater hope, is some form of organised effort by the State to achieve the following ends:—

(*a*) Elementary education to be made more real and practical; less "bookish," without diminishing its cultural value.

(*b*) The establishment of some system of compulsory attendance for continued education for all between the ages of fourteen and seventeen years.

(*c*) The linking together of the three main grades of educational effort.

(*d*) The complete coordination of the work of the evening continuation schools with that of the evening technical schools.

It is agreed by many observers, within and without our technical institutions, that technical education is rapidly approaching a crisis in so far as its higher work is concerned in the London polytechnics. The special feature of the moment is the relation of technical institutions to the university colleges. The association holds the opinion that there is room and to spare for the activities of both in those phases of their work which are common, and fully recognises that each has its own special function. It claims that the opportunity for complete study should be within the reach of every capable student, and that, too, in a sympathetic atmosphere. There is visible at the present time, both in London and the provinces, a tendency, under the guise of coordination, to curtail this higher work in both science and technology in these technical institutions, and thus to reduce seriously the students' opportunity. This tendency, if carried into effect, would be disastrous, under present social conditions, to the highest interests of national education, especially as regards the evening students.

H. ADE CLARK.

AN ORNITHOLOGIST IN QUEENSLAND.

IN June last the editors of the *Emu* issued a special number (vol. viii., part v.) containing a very interesting account, by Mr. S. W. Jackson, of a trip to northern Queensland in search of the nest and eggs of the tooth-billed bower-bird (*Scenopaestes dentirostris*). The expedition was undertaken on behalf of Mr. H. L. White, and appears, in spite of many difficulties, to have been eminently successful in the attainment of its object. The exploration of the tropical forests of Australia is by no means devoid of danger. Mr. Jackson himself was laid up for a week with "Johnstone River fever," which he regards as the almost inevitable price of his wanderings in the moist, fever-stricken scrubs, and one of his natives was killed by the falling branch of a tree, while the "scrub-itch mites" appear to constitute a plague of no mean order. It was a long time before he succeeded in obtaining the nests and eggs of the tooth-bill, though the playing-grounds were met with in great abundance.

A detailed, though unfortunately somewhat disconnected, account is given of the habits of these truly remarkable birds. They were first observed shortly before the commencement of the breeding season, each one occupying his own particular playing-ground without a mate. The play-grounds are cleared from dead leaves and other débris, and decorated with large fresh leaves placed face downwards. The leaves used are of various kinds, though sometimes only one kind may be found in a particular play-ground. The work of decoration is carried out afresh every morning, the leaves of the previous day being thrown on one side and new ones substituted. "Up to 6 a.m. they appeared to be hard at work clearing their bower floors of the old leaves and re-carpeting them with fresh ones, and until this early house-work was done they appeared to be in little mood for song or mimicry. I came across them hard at their re-furnishing, and carrying the long, heavy leaves in their bills *by the stems*, and just as they had severed them from the trees." The birds feed upon a kind of red berry, not yet identified, and the author is inclined to think that the serration of the beak has nothing to do with the collection of food. It is, however, apparently of use in cutting or sawing off the leaves for the decoration of the playing-ground, as was actually observed.

The tooth-bills are wonderful mimics, and Mr. Jackson gives a graphic account of their vocal performances. They seem able to imitate almost all the characteristic sounds of the forest, from the distinctive notes of other birds to the "pulsating rattle of a captured cicada."

After many disappointments the nests were at length found in very tall trees, very loosely constructed of twigs and containing only two eggs of a uniform brown colour. The character of these eggs leads the author to the conclusion that the tooth-bill is really a cat-bird, and not a true bower-bird at all. We cannot refrain from quoting the description of the finding of a pair of these eggs:—"The nest is placed fully 90 feet from the ground, in a mass of dense vegetation at the top of a bean or scrub chestnut-tree (*Castanospermum australe*). The climb is an awkward one, and our best black, who had examined the nest in the first instance, is again chosen to tackle the task. Strapping the egg-pouch around his waist, I say 'Good luck!' and up he goes. Placing the perpendicular and suspended vines between the first and second toes of each foot, he simply walks up, with marvellous and untiring agility. Making his way through the masses of vines and foliage near the top, he at length gains the rare nest, and suddenly exclaims, 'Two pfeller heg sit down!'"

Although the tooth-bill was the main object of the author's quest, the account of his wanderings contains much interesting information about other birds and some very good photographs, and is well worthy of perusal by all field naturalists.

INTERCHANGE OF UNIVERSITY STUDENTS.

In July last (vol. lxxxi., p. 55) we directed attention to a scheme, which is in course of development, to provide an interchange of university students between the United Kingdom, Canada, and the United States. It was pointed out on that occasion that the objects in view are to enable as many as possible of the educated youth of the countries named to obtain some real insight into the life and customs of other nations at a time when their own opinions are forming, with a minimum of inconvenience to their academic work and the least possible expense. The scheme will afford technical students facilities to examine into questions of interest to them in manufactures and so on, by observation in other countries, and will allow men of one part of the Empire to realise the needs and potentialities of the others.

Among the immediate needs of the executive committee in charge of the scheme, it may be mentioned that, to cover the estimated expenses of twenty-eight annual travelling scholarships, and of two students' travelling and information bureaux (one in Great Britain and one in America) for a provisional period of three years, in which the value of the scheme can be successfully demonstrated, a total sum of 13,000*l.* is needed. This is to be raised in three amounts, proportionate to the expenses incurred:—from the United States, 4500*l.*; from Canada, 1800*l.*; and from the United Kingdom, 7500*l.* There is not likely to be any difficulty in raising the money required in Canada and the United States. British students will incur more expense than others on account of the distances to be covered on the other side by the scholars, who will travel through Canada to the Pacific coast and return *via* the United States.

The committee hopes to be able to complete the organisation so that exchanges may be effected for 1910. To enable this to be accomplished, the treasurer (Lord Brassey) should receive promises to the amount of 7500*l.* within the next month.

Thanks largely to the practical support of the president of the movement (Lord Strathcona), who combines the Chancellorships of Aberdeen and McGill Universities with his work as High Commissioner of Canada, a central office has been established at Caxton House, Westminster. The travelling students will have the advantage of reduced rates of travel, of the special information which the bureau will be able to afford, and of the privilege of being brought, so far as possible, into contact with the actualities of those countries to which they go, whether persons, places, or institutions. A publication of great utility in connection with the movement will be compiled by the bureau.

The arrangements for the other side of the Atlantic also have made good progress. There is to be a bureau in New York under the direction of an American secretary, while at either Montreal or Toronto there will be a representative of the Central Bureau established in London, which forms the headquarters of the movement and the centre for the British Empire. In this connection, also, it may be mentioned that hopes are entertained of the opening in London of a common room for the convenience of the students concerned. The movement has been taken up by prominent educationists and others in the United States and Canada. Under the direction and guidance of the bureau the scholars, selected in the manner previously described, will travel for ten weeks during the long vacation through the respective countries. In order to elicit close observation, a detailed report of the tour will be required from every scholar. Donation forms, and all further information, can be obtained from the honorary secretary, the International Interchange of Students, Caxton House, Westminster, S.W.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

We learn from the *Revue scientifique* that the inauguration of the new Swiss university at Neuchatel took place on October 19. The University has grown out of the Neuchatel Academy, which was founded in 1866 and was re-organised in 1894.

Major Craigie, the Gilbey lecturer at Cambridge in the history and economics of agriculture, will give two lectures on "The History of Canadian and Australian Development and its Effect on British Agricultural Conditions" on November 17 and 18, at 5 p.m., in the University Chemical Laboratory.

Prof. Percival has resigned the directorship of the department of agriculture and horticulture of University College, Reading, and has been appointed to the post of professor of agricultural botany. Mr. Ronald V. O. Hart-Synnot has been appointed director of the department of agriculture and horticulture in succession to Prof. Percival.

The trustees of Princeton University, we learn from *Science*, have accepted the gift of 100,000*l.* of Mr. W. C. Proctor, of Cincinnati, made on condition that an equal sum be obtained by May 1, 1910. Haverford College has received 20,000*l.* to establish a fund for pensioning its professors. The General Education Board in the United States has made a conditional grant of 25,000*l.* to Ohio Wesleyan University, at Delaware, O. Mrs. Charles E. Perkins, of Burlington, Ia., has given 6000*l.* to Harvard University, to establish scholarships for students from Iowa. Harvard University also has received gifts amounting to 1320*l.*, to be used for the immediate benefit of freshmen in Harvard College.

The President of the Board of Education received a deputation from the County Councils Association Rural Education Conference on November 3. At a meeting last July the conference passed resolutions in favour of manual training, such as handicraft and gardening for boys and needlework and cookery for girls. On behalf of the deputation, Mr. Hobhouse explained that the resolutions were intended to express a widespread and growing feeling that elementary education should be brought into closer touch with the practical activities of daily life. The agricultural classes have hitherto been unduly prejudiced against the present system of elementary education as being mere book-learning, tending to unfit children for industrial occupations and calculated to produce only clerks and errand boys. The resolutions state that in the opinion of the conference it is not only desirable, but essential, that some form of manual training shall be given in every elementary school and throughout school life. It is often impossible, in the first place, to find teachers qualified to give the necessary instruction. The second difficulty is that of buildings and equipment. Wherever possible in rural schools a room should be provided and a plot of ground secured for practical instruction. Thirdly, while in concentrated populations the present grants for special subjects may be adequate, they are quite insufficient as regards scattered populations. In his reply, Mr. Runciman said the object of the Rural Education Conference may be summed up shortly—that it is sought to make the education of the children in the public elementary schools more practical and less bookish, to make it, in fact, deal more with things than with ideas, and to adapt it more to the special requirements of particular localities. With these objects he said he is in general sympathy, and the Board of Education has shown its approval of them by the changes it has made in the curriculum. The Board has attempted, so far as possible, to encourage the experiments enumerated by the conference; the real pity is that the experiments are so few. This is the fault of the teachers and the local authorities. Even in cases where the equipment is so small that it is impossible to carry on the work, the Board has done what it can to encourage the work of the peripatetic teachers. The gardening classes in elementary schools, as shown in the statistics of his department, have largely increased in number of recent years, and only within the last few weeks an important new departure has been made in arranging for the coordination of the work of the Board of Education with that now done by the Board of Agriculture.

LORD ROSEBERY, as Chancellor of Glasgow University, presided on November 5 at a dinner of the Glasgow University Club, London. In proposing "The University and the Club," Lord Rosebery remarked that there is nothing more interesting at this moment in the non-political aspect of England than the sprouting up of new universities all over the country. This shows an uprising of an intellectual interest which is full of promise at a time when all in the future of this country does not seem equally happy in expectance. These universities are the result of a real desire on the part of the people to partake of the higher, and perhaps even more of the technical, education that the universities afford. The universities are an outward and visible sign of a grace which is not likely to remain inward, but is likely to show itself in the influence of our national destinies. Lord Rosebery later remarked that he cannot help watching with an intense and almost a timid interest the outcome of the teaching of the universities. The destinies of this country are likely to be moulded indefinitely for good or for evil, in the course of the next few years, by the men of ability, and still more the men of character, who rise in each generation to mould their fellows. He hopes that the University of Glasgow will have many such missionaries of Empire, many men who are prepared with strong backs to wrestle and to stand for the truth, to oppose error in whatever place they may find it, and to remember that though they may be working in their own professions, for their own aims most of their time, yet there is part of their time which they owe to the traditions of their own university and to the welfare and future of the Empire itself. Lord Rosebery believes that Oxford and Cambridge have a great task still before them in the advancement of studies which must always appeal to a large, a leisured, and a learned section of the nation; but he is doubtful if grafting on to the ancient institutions newer technical schools is likely to answer to them or to the schools which they are attempting to found. Every university has, or should have, a character of its own, and the characters of Oxford and Cambridge are so strongly marked out, and they have so venerable a tradition to support them, that they need no special modern adjuncts, and Lord Rosebery doubts that they are likely to profit by them much, for, in truth, on the new grounds they cannot compete with the newer universities. The newer universities were founded with the object of promoting those practical and technical branches of knowledge for which the increasing demands of the age have gradually called.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 4.—Sir Archibald Geikie, K.C.B., president, in the chair.—Colonel Sir David **Bruce**, Captains A. E. **Hamerton** and H. R. **Bateman**, and Captain F. P. **Mackie**: (1) The development of *Trypanosoma gambiense* in *Glossina palpalis*; (2) a note on the occurrence of a trypanosome in the African elephant.—The Lord **Rayleigh**: The perception of the direction of sound.—Prof. H. M. **Macdonald**: The diffraction of electric waves.—R. **Houstoun**: The mechanism of the absorption spectra of solutions.—Hon. R. J. **Strutt**: (1) Note on the spontaneous luminosity of a uranium mineral; (2) the accumulation of helium in geological time, ii. The second paper is a continuation of that published in Proc. Roy. Soc., A, vol. lxxxi., 1908, p. 272, the object being to determine the ratio of helium to radio-active matter in minerals as a means of measuring their age. The data given refer chiefly to the iron ores of sedimentary strata. Even some of the most recent are found to contain quantities of helium, denoting great antiquity. Thus ironstone from the Eocene beds of Co. Antrim contains, per gram, $2{\cdot}64\times10^{-4}$ grs. uranium oxide (U_3O_8), $8{\cdot}27\times10^{-4}$ grs. thorium oxide, and $12{\cdot}1\times10^{-4}$ c.c. helium. This, interpreted according to the best available data, would imply an age of thirty million years. Experiments of a preliminary character have been made to determine directly the rate of growth of helium in thorianite and in pitchblende. The data thus obtained will give the rate of formation of helium by the complete series of uranium and thorium respectively, and thus make it possible to interpret more definitely the results of experiments on other minerals for which a direct determination is not feasible; 400 grams of thorianite was found to yield in seven weeks a quantity of helium certainly less than 2×10^{-6} c.c. The annual rate of production per gram of thorianite is, therefore, certainly less than $3{\cdot}7\times10^{-8}$ c.c. The 9 c.c. initially present cannot, therefore, have accumulated in a less time than 240 million years. An experiment on pitchblende of a similar character was consistent with Rutherford's estimate of the rate of production by the uranium series, but was not on a sufficient scale to afford complete confirmation. Experiments on a larger scale are in progress.—J. C. **Chapman** and H. L. **Porter**: The physical properties of gold leaf at high temperatures.—Dr. H. C. **Pocklington**: The dimensions and function of the Martian canals. The nature of the bed of the canals is guessed from Lowell's value of the velocity of flow along them, and then the depth is calculated from the technical formulæ, assuming that the canals are horizontal and carry water from pole to pole. The depth is 500 feet if the canals are as narrow as possible, or 370 feet if they are 4500 feet wide. The amount of water required to fill the canals is determined. To find the function of the canals, it is assumed that their arrangement is the most economical, and it is deduced that they are essentially lines of communication, though, of course, they may also serve to carry water for irrigation.

Physical Society, October 22.—Dr. C. Chree, F.R.S., president, in the chair.—F. E. **Smith**: Cadmium amalgams and the Weston normal cell. Cadmium amalgams may be solid, liquid, or a mixture of solid and liquid phases, the composition of the phases depending on the temperature. When a liquid amalgam is cooled below the lower transition temperature, the centre of the resulting solid is of high cadmium concentration, and the outer skin of low cadmium concentration. Diffusion tends to produce uniformity, and in consequence the E.M.F. of a cell containing the amalgam is unstable for a considerable length of time. When the amalgam is cooled to a temperature a little below the lower transition temperature, the difference of concentration between the inner and outer parts of the amalgam need be only small to enable the outer skin to be a two-phase system. The diffusion process will be slow, and the E.M.F. may remain constant for a long time. Amalgams which were of uniform cadmium concentration were obtained by chilling liquid amalgams to a temperature of about −50° C.; although not initially stable, rapid diffusion processes resulted in these amalgams becoming approximately uniform throughout after a few days, and their electromotive properties were different from those of slowly cooled amalgams. The experiments indicate that a 12·5 per cent. amalgam may be used safely at all temperatures between 12° C. and 60° C., and a 10 per cent. amalgam at all temperatures between 0° C. and 51° C. Experiments were made on the temperature coefficients of the anode and kathode limbs of the Weston normal cell, and show that if a difference of temperature of 1° C. exists an error of about 3 parts in 10,000 is introduced.—F. **Soddy**: Production of radium from uranium. The measurements on the growth of radium in the three uranium solutions purified between three and four years ago have shown that in all the growth of radium is proceeding at a rate proportional to the square of the time. The ordinary error is not greater than 10^{-12} gram of radium. This result indicates the existence of only one long-lived intermediate product in the series between uranium and radium. The period of average life of this body is 18,500 years in the case of the oldest solution for which data are available; but for the solution prepared last, the period indicated is about half again as long as in the first experiment. Had this solution grown radium at the same rate, with reference to the square of the time, as the older solution has done during the past year, more radium should have been formed than the *total* amount now actually present. This suggests the existence of at least one new intermediate product in the series "uranium A." From a mathematical investigation of the effect of such a body on the rate of growth of radium, it is concluded that it would not, if it existed, appreciably alter the production of radium over the period accurate observations have been made; but its existence would vitiate the calculation of the period of the direct parent of radium according to the simple formula neglecting short-lived products.—F. **Soddy**: The rays and product of uranium X. Experiments have been made with the uranium X preparations separated from 50 kilograms of pure uranyl nitrate. There occurred the growth of a feeble α radiation as the intense β radiation decayed. Such a growth of α rays, concomitant with the decay of β rays, is to be expected if the parent of radium is the direct product of uranium X. From the period of the parent of radium, the uranium X in equilibrium with 1 kilogram of uranium should give by its complete disintegration a product having the α activity of 2 milligrams of uranium if no new intermediate bodies intervened. The preparations of uranium X were examined in a magnetic field sufficient to deviate all rays having a value for $H\rho$ less than 8640, but the still undeviated β radiation produced a leak in the electroscope several times greater than that due to the γ rays. These difficultly deviable β rays are similar in general character and in the value of their absorption coefficient to ordinary β rays. The first measurements were made in an electroscope filled with air. Later, the electroscope was filled with hydrogen, which constituted an enormous advance, and these experiments have shown that the α radiation of the preparation remains constant as the β radiation decays. Anomalies have been encountered with the difficultly deviable β radiation, which appears to vary in intensity according to the conditions; but throughout the "difference leak" between the preparation bare and covered, due to α rays, has remained constant in all the preparations examined. These measurements of the α rays, for different preparations, cover a period from immediately after preparation to nearly a year in the case of the main preparation, and longer periods in the case of weaker preparations. The two most recent preparations each contained the uranium X in equilibrium with about 5 kilograms of uranium, and the growth of α rays if the change of uranium X into the parent of radium were direct should be equal to the α radiation of 10 milligrams of uranium. The parent of radium cannot be the direct product of uranium X. The experiments indicate that it is not a product of uranium X at all, but the subsequent history of the uranium X preparations must be awaited before this can be decided.—F. **Soddy**: The production of helium from uranium and thorium. Helium has been detected in four experiments with uranium, in three with thorium, and in one with pitchblende solutions carried out according to the methods already published. Recent experiments with nearly a year's accumulation of helium from about 2 kilograms of uranium and thorium respectively have ended in failure owing to accidents.

Challenger Society, October 28.—Sir John Murray, K.C.B., F.R.S., in the chair.—Prof. d'A. W. **Thompson**: A new method of estimating the number of fish which escape through the meshes of the trawl. The first step was to envelop the trawl-bag loosely in a net of finer mesh, so that the catch was divided into larger specimens inside the trawl and smaller specimens between the trawl and the outer envelope. When curves of these two classes were plotted on the basis of numerous experiments, they naturally overlapped, the overlap representing fish of a length intermediate between those which could not possibly get through the trawl-mesh and those which were certain to slip through it. From the overlapped area a ratio could be deduced and tested in both directions against the curves, which appeared to give a fair measure of the small fish lost by an ordinary trawl without a finer envelope.

PARIS.

Academy of Sciences, November 2.—M. Bouchard in the chair.—M. **Le Chatelier** and S. **Wologdine**: The phosphides of iron. Of the nine apparent phosphides examined, only four have a certain existence, viz. Fe_3P, Fe_2P, FeP, Fe_2P_3, but the composition of the last two is not so certainly established as that of the first two.—A. **Calmette** and C. **Guérin**: Some properties of tuberculous bacillus of bovine origin, cultivated on glycerinated beef bile. Experiments had shown that when guinea-pigs were inoculated with bacillus cultivated in this manner, a much greater virulence was developed, this, however, becoming steadily diminished by successive cultures. Further experiments on horses and heifers showed that with the former the virulence was not only increased, but remained so, while the latter showed the decreasing virulence evident in the guinea-pig.—M. **de Forcrand**: The bicarbonates of rubidium and cæsium. They form anhydrous crystals, stable on exposure at ordinary temperatures, neither absorbing water nor evolving carbon dioxide. The solubilities are much greater than that of potassium bicarbonate, whilst they are also more stable under heat.—J. **Bosler**: Magnetic perturbations and solar phenomena. Observations were made on the violent magnetic storm of September 25.—A. **Perot**: A means of protecting the silvering of mirrors. This consists in re-covering the mirror with an extremely thin layer of transparent celluloid. If the layer is only sufficiently thin, images remain intense, complete, and do not show diffusion.—P. **Helbronner**: The geodetic complementary triangulations of the high regions of the French Alps. The number of geodetic stations in this district has been raised to 126, of which fifteen are above 3000 metres and forty between 2000 and 3000 metres.—M. **Darmois**: The composition of the essences of terebenthine. The method indicated, based on the measurement of rotatory dispersion, suggests that the essences of terebenthine contain (1) pinene under its two forms; (2) a lævo-carbide in large quantity.—M. **Devaux-Charbonnel**: Note on an attempt to realise an artificial telephonic line.—H. **Baubigny**: Action of heat on the sulphite and double alkaline sulphites of silver. Formation of dithionate. The author believes that during decomposition at 100°, in presence of water, of silver sulphite, and the double alkaline sulphites, the production of di-thionic acid is the principal result.—C. **Gerber**: Localisation of proteolytic ferments in *Vasconcellea quercifolia*. There seems to exist a relation between the enzyme-forming character of certain plants and the coagulability of their latex.—E. **Kayser** and E. **Manceau**: The viscosity ferments of wines.

These are thick bacilli, of length usually less than 2 μ; all are sugar ferments, and anærobic.—B. **Collin**: The hypertrophied forms and degenerated growth among the Acinetians. Intensive culture and constant over-feeding are capable of producing on the organism of these infusoria profound modifications, both morphological and physiological.—Ph. **Dantzenberg**: The marine molluscs found in the scientific expeditions of M. A. Gruvel in West Africa, 1906–9.—W. **Wietrzykowski**: Contributions to the study of the development of Lucernarids.—G. **Eisenmenger**: The glacial excavation of Lake Garda (Italy). If the origin of the Lake of Garda is a tectonic depression dating from Mesozoic, or if, later, different movements took place with a dislocation of Mount Baldo, it is necessary to recognise that the actual configuration of Lake Garda is the work of a very powerful glacial excavation.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 11.

ROYAL SOCIETY, at 4.30.—The Vacuolation of the Blood-platelets—An Experimental Proof of their Cellular Nature: H. C. Ross.—Further Results of the Experimental Treatment of Trypanosomiasis—being a Progress Report to a Committee of the Royal Society: H. G. Plimmer and Captain W. B. Fry.—*Hillhousia mirabilis*, a Giant Sulphur Bacterium: G. S. West and B. M. Griffiths.—The Modes of Division of *Spirochaeta recurrentis* and *S. duttoni* as observed in the Living Organism: H. B. Fantham and Miss A. Porter.—On the Supposed Presence of Carbon Monoxide in Normal Blood and in the Blood of Animals anæsthetised with Chloroform: G. A. Buckmaster and J. A. Gardner.—The Origin and Destiny of Cholesterol in the Animal Organism. Part vi., The Excretion of Cholesterol by the Cat: G. W. Ellis and J. A. Gardner.—The Elasticity of Rubber Balloons and Hollow Viscera (with a Note by W. Sutherland): Prof. W. A. Osborne.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—(1) The Ordinal Relations of the Terms of a Convergent Sequence; (2) The Application to Dirichlet's Series of Borel's Exponential Method of Summation; (3) Theorems relating to the Summability and Convergence of Slowly Oscillating Series: G. H. Hardy.—Notes on Synthetic Geometry: Prof. W. Esson.—Kummer's Quartic Surface as a Wave Surface: H. Bateman.—The Green's Function in a Wedge, and Other Problems in the Conduction of Heat: Prof. H. S. Carslaw.—The Envelope of a Line cut Harmonically by two Conics: J. L. S. Hatton.—On a Case of q-Hypergeometric Series: Rev. F. H. Jackson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presidential Address: Dr. Gisbert Kapp.

FRIDAY, NOVEMBER 12.

PHYSICAL SOCIETY, at 8.—On the Absorption Spectrum of Potassium Vapour: P. V. Bevan.—Some Further Notes on the Physiological Principles underlying the Flicker Photometer: J. S. Dow.—Exhibition of a Colour-perception Spectrometer: Dr. F. W. Edridge-Green.—Tables of Ber and Bei and Ker and Kei Functions, with Furthur Formulæ for their Computation: H. G. Savidge.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Observations of Jupiter, 1907–8: Scriven Bolton.—On the use of an Ordinary Telescope in the Zenith for Determination of Time and Latitude: R. H. M. Bosanquet.—Star Colours and Spectral Types: Stars of Spectrum Type O: W. S. Franks.—Observations of Jupiter's Galilean Satellites, 1909: R. T. A. Innes.—The Effective Temperature of 109 Fixed Stars: J. Wilsing and J. Scheiner.—A New Map of the Moon: W. Goodacre.—An Addition to the Theoretical Secular Acceleration of the Moon's Mean Motion: E. W. Brown.—An Error in the New Lunar Theory: E. W. Brown.—On the Plans for New Tables of the Moon's Motion: E. W. Brown.—The Magnetic Storm of 1909 Sept. 25, and the Associated Solar Disturbance: W. J. S. Lockyer.—A Solar Outburst and a Magnetic Storm: C. Michie Smith.—Spectroscopic Determination of the Systematic Motions of the Stars: S. S. Hough and J. Halm.—Mesures récentes sur la Planète Mars: R. Jonckheere.—Aberration Day Numbers for 1910: H. C. Plummer.—Description of the Society's Harrison Clock: E. T. Cottingham.—The Cyclones of the Indian Ocean, 1856–67, and their Association with the Solar Rotation: E. W. Maunder.—*Probable Papers*: Solar Parallax Papers, No. 8, The Mass of the Moon derived from Photographic Observations of Eros, 1900–1: A. R. Hinks.—The Sun-spots and Associated Magnetic Storm of 1909 September and October: Rev. A. L. Cortie.

MONDAY, NOVEMBER 15.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Mesopotamia: Past, Present, and Future: Sir William Willcocks, K.C.M.G.

TUESDAY, NOVEMBER 16.

MINERALOGICAL SOCIETY, at 8.—Anniversary Meeting.—On an Occurrence of Native Copper with Tin Ore in the Federated Malay States: J. B. Scrivenor.—On a Meteoric Stone from Simondium, Cape Colony: Dr. G. T. Prior.—On Sartorite and other Minerals from the Binnenthal: Prof W. J. Lewis.—On the Occurrence of Alstonite and Ullmannite, a Species New to Britain in a Barytes-witherite Vein in the New Brancepeth Colliery, near Durham: L. J. Spencer.—A Pocket Sclerometer: C. J. Woodward.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion*: The Single-phase Electrification of the Heysham, Morecambe and Lancaster Branch of the Midland Railway: J. Dalziel and J. Sayers.—The Equipment and Working-results of the Mersey Railway under Steam and under Electric Traction: J. Shaw.—The Effect of Electrical Operation on the Permanent-way Maintenance of Railways, as Illustrated on the Tynemouth Branches of the North-Eastern Railway: Dr. C. A. Harrison.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Rothwell Crania: F. G. Parsons.

ROYAL STATISTICAL SOCIETY, at 5.—Inaugural Address: Sir J. A. Baines, President.

WEDNESDAY, NOVEMBER 17.

ROYAL SOCIETY OF ARTS, at 8.—An Imperial Navy: Sir W. H. White, K.C.B., F.R.S.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Methods Employed for Observing Pilot Balloons: C. J. P. Cave.—Registering Balloon Ascents at Gloucester, June 23 and 24, 1909: W. Marriott.—Winter Temperatures on Mountain Heights: W. P. Brown.—The Semi-diurnal Variation of Rainfall: E. Gold.

GEOLOGICAL SOCIETY, at 8.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On the Recent and Fossil Foraminifera of the Shore Sands of Selsey Bill, Sussex; Part iv.: Edwd. Heron-Allen and A. Earland.

THURSDAY, NOVEMBER 18.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: The Statistical and Thermodynamical Relations of Radiant Energy: Sir J. Larmor, Sec. R.S.

LINNEAN SOCIETY, at 8.—A New Tipulid Subfamily: W. Wesché.—Freshwater Rhizopods from the English Lake District: J. W. Brown.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, NOVEMBER 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—An Internal-combustion Pump and other Applications of a New Principle: Herbert A. Humphrey.

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THURSDAY, NOVEMBER 18, 1909.

CYTOLOGICAL ASPECTS OF CERTAIN BIOLOGICAL PROBLEMS.

Zeitpunkt der Bestimmung des Geschlechts, Apogamie, Parthenogenesis, und Reduktionsteilung. By E. Strasburger. Heft VII., Der Histologischen Beiträge. Pp. xvi+124. (Jena: Gustav Fischer, 1909.) Price 6.50 marks.

IN the seventh part of his "Histologische Beiträge," Prof. Strasburger records and discusses the results of investigations on a number of cytological problems chiefly related to the nature and distribution of sex. The reader will recognise the facile grasp of wide and complex series of facts, as well as the lucid presentation of the conclusions, which form so strongly marked a feature of the works of this great investigator.

The opening chapter is devoted to an account of studies on the sexual differentiation in the spores of the diœcious liverwort Sphærocarpus. The result of cultures of the spores of this plant brings out the remarkable fact that on the average two spores in each tetrad give rise to male, and the two other ones to female individuals. This distribution does not occur invariably, but it does so in the great majority of cases, and the discovery is of considerable importance and interest. It is clearly in harmony with, and gives greater precision to, the observations already made by others on the distribution of sex in other liverworts and mosses. In the case of the plant in question, it indicates that the sex of the individual to which the spore will give rise is predestined during the meiotic divisions of the spore mother cell—the divisions in which we have good grounds for supposing that many other characters are segregated and distributed. It will be remembered that it is at meiosis that the nuclear chromosomes are *distributed* between the nuclei of two daughter nuclei, so that their number in each of these nuclei is consequently halved. But the coincidence needs to be utilised with caution, and Prof. Strasburger himself fully discusses the difficulties in the way of generalising too freely.

It is obviously necessary to distinguish clearly between the characters appropriate to the sexual cells (or to the gametophytes) themselves, and those sexual *tendencies* of which they are the bearers. The latter, of course, only declare themselves after fertilisation, when the sex of the particular individual of the next generation which springs from them is declared. Whilst it is quite possible, and in certain cases it can be very plausibly argued, that these sexual *tendencies* are decided at meiosis, it appears to be quite certain that the sexual *characters* must be regarded from a different point of view. Thus, notwithstanding the case of Sphærocarpus, where meiosis seems to determine the segregation of the resulting gametophytes into a pair of male and a pair of female plants respectively, a consideration of any heterosporous plant—as, for example, selaginella, suffices to remind one that here, at any rate, the sexual character of the gametophyte is determined by causes which operate before meiosis supervenes. For the difference can be detected in the sporangia. Still more clearly is the same thing apparent in diœcious plants, where the male and female individuals differ from each other, and thus the character of the gametophytes to which they will severally give rise can be foretold at a much earlier stage in the life-history.

With regard to the segregation of the sexual tendencies the matter is otherwise. Although the questions herein involved are very complex, the evidence at present available seems to indicate that the segregation of the opposing sexual tendencies, where it occurs at all, is achieved at the stage and by means of the mechanism of meiosis. The fact that in the interpretations of sex, from this point of view, there exists a lack of unanimity as to the precise constitution of the male and female gametes does not materially affect the position. Thus the question as to whether maleness and femaleness can be regarded as allelomorphic (or alternative, as regards the constitution of the gametes) characters is independent of the views taken as to the heterozygous character, for example, of the male or the female, and it may turn out ultimately that different organisms behave differently in this respect. In this connection it may be mentioned that the alga *Chara crinita* produces only female plants from its parthenogenetically developing eggs, which contain the half number of chromosomes (haploid), whilst in ants, bees, and wasps the corresponding unfertilised, parthenogenetically developing eggs invariably give rise to males.

Intimately bound up with the question of sex are the various instances of eggs which are able to develop into a new individual in the absence of the normal union with a sperm. Strasburger rightly, as we think, criticises those who would include all these cases under the term parthenogenesis. Examples are known of eggs which possess the full premeiotic number of chromosomes owing to the obliteration of the meiotic phase from the life-history. Fertilisation is always absent in such cases, but it is misleading to speak of this as a parthenogenetic development, seeing that the nuclear constitution of such an egg deviates so fundamentally from that of a normal one. Possibly the term "diploid parthenogenesis" might be employed to meet such cases, though we confess to a preference for the word "parthenapogamy" as being more characteristic.

In dealing with the general question of apogamy, the author emphasises the suggestive fact that species which exhibit this feature commonly possess far larger numbers of chromosomes than allied and normal species, and also that they are characterised by a relatively high degree of variability. These two points appear to us to be highly significant, and to merit a closer attention than they have generally received.

Prof. Strasburger holds stoutly to his views as to the omnipotence of the nucleus in determining the course of development. That is to say, the nucleus is regarded as alone bearing the hereditary substance which he believes to consist of distinct bodies responsible for the characters manifested by an individual. He adheres strongly to the view, advanced by Grégoire, that homologous chromosomes (*i.e.* derived from the male and female parent respectively) pair laterally during the prophase of meiosis, and he discounts the speculations which have been based on mitochondrial and such-like cytoplasmic structures. As regards the interpretation of the nuclear transformations which occur during meiosis, Prof. Strasburger admits that he is influenced by theoretical considerations in arriving at his final conclusions. The views he advocates are not shared by all investigators, although at the present time they are rather widely supported. But the available evidence is hardly sufficient as yet to allow of the matter being brought to a decisive issue, and, indeed, the very same preparations have been differently interpreted by the exponents of the divergent views. It is a pity, perhaps, that this should be so, but it is clearly not an unhealthy condition of affairs when the final conclusion on a question of fact is confessedly influenced by other than objective evidence.

The reader will find many other topics treated in this volume by a master hand. Evidence is given to show that the hybrid *Fragaria virginiana* × *F. elatior,* which in the F_1 generation so exactly resembles the latter (male) parent that its hybrid nature has been doubted, does really arise in this way, but that the Elatior parent is completely dominant. Alternation of generations is touched upon, and the book ends with a suggestive speculation as to how the details of nuclear structure, and in particular the meiotic divisions, have come to exhibit so close a resemblance in the higher plants and animals respectively. It is pointed out that so remarkable a fact cannot be otherwise than pregnant with real significance, especially when we reflect that we seek in vain amongst the more primitive animals and plants for the uniformity which on *a priori* grounds we might, perhaps, have anticipated would be found.

It is impossible, in bringing this notice to a close, to refrain from expressing appreciation for the manner in which Prof. Strasburger has handled the more controversial matter in his book. The invariable courtesy with which he treats the opinions of those who happen to differ from himself might well be copied by some who still appear to imagine that scientific discussion should be conducted on the lines of modern politics. Not the least of the qualities which have endeared Prof. Strasburger to a wide circle of friends, in addition to that scrupulous fairness and consideration which he always shows to others, is the open-mindedness with which he is always ready to accept the result of new discoveries, even when, as he himself says, they may involve the sacrifice of long-cherished views.

J. B. Farmer.

METALLIC ALLOYS.

Leçons sur les Alliages métalliques. By Prof. J. Cavalier. Pp. xix+466. Illustrated. (Paris: Vuibert et Nony, 1909.)

During the last twenty years a systematic study has been undertaken of the properties of alloys, their chemical nature and constitution, and the relations between that constitution and their useful properties. The work has been made possible by the invention of trustworthy pyrometers, by the application of microscopic examination to opaque substances, and by advances in the knowledge of chemical equilibrium. The investigations have in many cases been carried out with an industrial aim, but by throwing light on the chemistry of solid bodies they have contributed largely to the development of pure science. It is true that the whole subject is still to some extent in a state of flux, and much remains to be done in order to explain apparent contradictions, and to remove the uncertainty and provisional nature of some of the conclusions. Nevertheless, it is time to make the fundamental principles of the science of alloys part of the course of training of students of general chemistry. Prof. Cavalier's book shows a pronounced superiority for this purpose over previous attempts, and is one of the manuals which teachers of chemistry may usefully place in the hands of their students. It is based on a series of lectures delivered by the author at the University of Rennes, and is characterised by clearness of thought and of language, logical arrangement, and perfection of balance.

The first part of the book contains a brief general description of the methods of preparation and study of alloys. Ordinary chemical analysis is not dealt with, but proximate analysis, and the still more important methods of microscopic metallography and thermal study are discussed, and the physical and mechanical properties are also considered. The treatment is elementary, and is hardly full enough to help those engaged in research, but it is sufficient for students to obtain some knowledge of the methods of determining the constitution of alloys. No attempt is made to set up a complete classification of alloys based on their constitution, but perhaps this need not be regretted when the artificial aspect of some of the previous attempts at classification is remembered.

The second part of the book contains the special study of certain alloys, and is intended to show by concrete examples how the general methods have been applied in practice, and what results have been obtained. There is no attempt to make this part complete by describing all alloys, the author referring the reader to Guillet's book, "Les Alliages métalliques," published in 1906, for details of those alloys which he has omitted to mention. However, Prof. Cavalier has chosen his examples from alloys presenting some industrial interest, and has passed in review most of the important groups. He has contented himself with a single example of each case met with in a systematic study, arranging his material as far as possible in the order of increasing complexity. Thus the simple case of alloys of gold and silver is taken first. The more complicated diagrams of equilibrium assigned to lead, tin and antimony are next dealt with, and these are followed by the brasses and bronzes, in which so many solid solutions occur. The relation between constitution and useful properties find a striking example in the antifriction alloys, and the iron-carbon alloys, of which the practical importance is fundamental, present difficulties in their study owing to the existence of a labile system, and are taken last.

In the section devoted to special steels the method of describing only a few typical alloys is discarded, and a catalogue of the steels is given with their composition and properties, as if a comprehensive book of reference were being written.

The faults of the book are the faults of a university professor when dealing with a practical subject. As soon as works-practice is touched on, the information is not to be trusted. Thus, in the chapter on the preparation of alloys, a somewhat misleading diagram is given of a melting furnace for crucibles, and the statement is made that the maximum charge for a crucible in such a furnace scarcely exceeds 100 kilograms. To show the inexactness of this, it is enough to mention that at the Royal Mint crucibles containing more than 180 kilogrammes of standard silver have been in use for many years, and even larger crucibles are used in mints abroad.

The merits of the volume have already been sufficiently indicated. It is a pleasure to read the book. It can hardly fail to fascinate many of the students into whose hands it will come as a task, and it will be useful to those engaged in the industries as an aid in understanding the numerous articles and papers on alloys which appear in scientific periodicals every day.

T. K. R.

OPEN-AIR STUDIES AT HOME AND ABROAD.

(1) *The Young Naturalist.* A Guide to British Animal Life. By W. P. Westell. Pp. xv+476. (London: Methuen and Co., 1909.) Price 6*s*.

(2) *Nature.* By J. H. Crawford. Pp. x+242. (London: Swan Sonnenschein and Co., 1909.) Price 5*s*.

(3) *Victorian Hill and Dale.* A Series of Geological Rambles. By Dr. T. S. Hall. Pp. x+160. (Melbourne: Thomas C. Lothian, 1909.) Price 3*s*.

(1) THE distinguishing feature of this survey of the British fauna is its comprehensiveness. With the exception of marine fish, there is no large order that does not come in for comment. The mammals, birds, fresh-water fish, and Lepidoptera—the most popular groups—are allotted most space, and are evidently more familiar to the author than the remainder. In spite of certain drawbacks, of which we shall have something to say, this book is a most suitable handbook for a boy or girl who is interested in animal life. The contents are arranged in ordinal fashion, and no attempt is made to deal with the associations of animals characterising field, moor, or lake, nor are there practical suggestions for the capture, maintenance, or preservation of specimens. There are, however, accounts of the habits and distinctive features of the commoner British animals that should be read with interest by young naturalists, and the wealth of clear photographs makes the book a most attractive one.

In dealing with the more familiar orders, the author's observations are evidently based on personal observation, but one can scarcely hope to extend this enviable acquaintance to all the groups, and accordingly there are occasions when the experience of others has to be drawn upon. Unfortunately, in these instances the authorities relied upon by Mr. Westell are not unimpeachable, and have been the cause of several misstatements. Thus, on p. 456, in speaking of the severing of a limb or part of the body, the author concludes, "This is known as autonomy." We can hardly believe the author responsible for mistaking the second "t" for an "n." But in other cases the authority is clear. On pp. 291–5 there is a description of the structure and life of fish that bristles with misleading or inaccurate statements:—"the fish's gills are its lungs"; "a fish need only open its mouth and the water pours in"; "the heart has two cavities"; "the fins along the back and the stomach are especially useful in keeping the body upright"; "probably the sense of taste and touch are only very dull"; "fishes (with one or two exceptions of tropical fishes) are hatched from eggs which are laid by the parent in very large number." Why the author should have trusted to such information instead of going to first-hand authorities we do not understand. The account of the mollusca contains several mistakes. Pearls are said to be due to "a grain of sand or other hard substance. Cephalopods "have no outside shell, the principal eight-armed Cephalopod is the Argonaut or Nautilus." This confusion is rendered still more distressing by a later note (p. 439), in which the "Paper Nautilus or Argonaut" is called "Nautilus pompilius," whilst the shell of the "common Nautilus" is figured and described as a distinct structure. There is a similar confusion between the acorn barnacle and Lepas, the goose-barnacle. The nomenclature, in fact, is inconsistent. On p. 49 the Linnean system is justified, and yet throughout the book confusion is continually arising through the want of its use. What are flat burying beetles or museum beetles? What is the Noonday Fly? Even Mr. Westell seems to become confused by this absurd nomenclature, for he tells his readers to look for the "brine shrimp" in the sea; and evidently believes in some abstraction called the *real* shrimp (p. 316). But for thorough confusion of thought, take the statements that the Brittle Star "ably practises (*sic*) this remarkable habit (of fragmentation) for it casts away in regular and methodic manner certain parts of its body during its early life," or this one of the house fly, "accused often unjustly of disseminating disease, it seems that according to Sir James Crichton Browne, there is much truth in a good deal of what has been stated."

The style of the author really needs a little chastening. "Vasty deep"; "Denizens of the deep"; "I having made observations upon the insects but not them upon me" (p. 423); "despite the hue and cry which one hears so frequently as to the dense human population that this country harbours," p. 169 (as though humans were a kind of vermin), are a few expressions that should have been cut out. We know how easy is the task of picking out weak places in the work of others, and direct attention to these flaws in a very useful book in the hope that a new edition (which certainly ought to be called for) may be even better than this one. References might then be given, in the text, to the attractive illustrations. This is a very necessary, even an essential matter, for the adder, *e.g.*, is figured on p. 20, and the description of it is not given until p. 276, where no reference to the foregoing figure occurs. The same dislocation of figures occurs in many groups.

(2) Mr. Crawford is an impressionist, and one who shares the Wordsworthian spirit. In these slight word-pictures of east-coast scenery he sketches, in a very dainty and observant fashion, the picturesque features of animal life as seen against the varying background of nature's moods. He believes, and reiterates his belief in, the value of our response to such beauty. He is an artist.

"We think in pictures. We recall in pictures. We remember more than we see. With this aid, to evolve our artistic sense were easy, to add a touch of imagination were not hard. Thus, simply, might the world be made to seem beautiful and life be filled with gladness."

These essays will perhaps not add to Mr. Crawford's reputation, but they will certainly not detract from it.

(3) This little book is mainly a reprint of articles on the geology of Melbourne and neighbourhood contributed to the *Melbourne Argus*, but also includes a survey of the strata round Port Phillip Bay and up country to Ballarat and Bendigo. The bedrock, of Silurian age, is characterised by rough, dark-barked gum-trees, and is economically of great importance for the making of pottery and bricks. The wearing down of this rock has produced the gravel beds in which the gold of the bedrock is found. These gravel beds have also their characteristic flora, the grass-trees. Intersecting these are granitic rocks which have weathered out, and support a flora of native cherries, white-barked gums, and other trees. The vast blue-stone plains have been formed by eruptions of lava emerging through the bedrock, and are distinguished by their grassy, treeless appearance. In addition there are glacial beds in many districts, and cinder beds in a few others, supporting dense forest and forming rich farm land. The descriptions are very clear, and are illustrated by good photographs.

ELECTROMAGNETIC THEORY.

(1) *Anfangsgründe der Maxwellschen Theorie, verknüpft mit der Elektronentheorie.* By Franz Richards. Pp. ix+245. (Leipzig: B. G. Teubner, 1909.) Price 7 marks.

(2) *The Theory of Electrons, and its Applications to the Phenomena of Light and Radiant Heat.* By H. A. Lorentz. Pp. iv+332. (Leipzig: B. G. Teubner; London: David Nutt and Williams and Norgate, 1909.) Price 8 marks.

(1) THE first of these volumes deals with the foundations of Maxwell's electromagnetic theory. The author is careful to point out that it is not a text-book, but a sketch based on lectures delivered to teachers. For this reason the treatment differs somewhat from what may be regarded as the normal method of presenting the subject to students; although in a branch of physics which appeals to a comparatively limited class, it may be doubted whether there are satisfactory grounds for introducing preferential treatment.

At an early stage the author shows how the two fundamental "circuital relations" are connected by means of the principle of least-action. This is an excellent feature, and the proof would probably have produced greater impression had some definite physical picture, such as that adopted by Larmor, been introduced.

In succession, the author treats of static effects in non-conductors, of conduction, and of magnetic effects of currents. The introduction of Stokes' theorem, which is delayed until this stage, might, with advantage, have been introduced much earlier.

Induction is next discussed, and finally there is a chapter on electromagnetic waves, which closes with a brief and rather imperfect treatment of metallic reflexion.

As a whole the book is somewhat disconnected, but it ought to be judged as a collection of monographs, and from this point of view the treatment is clear and good.

(2) Lorentz' book deals with the latest development of the electromagnetic theory. It contains a series of lectures delivered in Columbia University, New York, in 1906, and will be welcomed as his latest views on a subject which owes its origin and much of its development to Lorentz himself.

There are five chapters and a section of notes, which give calculations too elaborate to be included in the text. Chapter i. treats of general principles and the doctrine of free electrons. It is to Lorentz that we owe the view that the free æther is to be regarded as at rest, and that hence phenomena in it are governed by the two "circuital" and the two "solenoidal" equations of Maxwell.

At discrete points we may have electrical singularities characterised by a certain density. The effect of this at those points is simply to make the electric divergence equal to the density, instead of nil, and to add to the displacement current, a portion due to convection of amount equal to the product of density and velocity. At other points in the æther the effects are sufficiently included in the four fundamental equations. It is of importance to notice that this specification imposes a limitation on the internal character of an electron. Thus if an electron is defined as a shell with a surface charge of electricity, its interior must, on the basis of Lorentz' equations, consist of nothing but æther. The limitation carries important consequences, such as prescribing surface conditions.

In this chapter the author discusses the question of electric inertia on the basis of Kaufmann's experiments; but as he again takes up the question more fully in a later chapter, it will be convenient to reserve our observations.

Chapter ii. is devoted to the question of radiation and absorption of heat. Those who have followed the interesting discussion on this matter in the *Physikalische Zeitschrift* recently, will not be surprised to find that Lorentz devotes some space to the question whether the æther and the radiating body, supposed to consist of electronic radiators, can be regarded as a system to which the law of equipartition of energy can be applied. The result of such an assumption is in flat contradiction to observation. As the law of equipartition has never been proved for purely dynamical systems, and is probably not in general true, it is not surprising that it fails when applied to the æther.

The Zeeman effect is discussed in chapter iii., and the author is chiefly concerned in showing how little progress has been made in elucidating the phenomena, and how much knowledge of atomic structure we may reasonably hope to gain from study of the facts.

The electron theory of dispersion is next dealt with. Probably most readers will regret that the author has not found it possible to enter more fully on the problem of the optical properties of metals.

Optical phenomena in moving bodies forms the subject of the last chapter. The explanation of Fresnel's hypothesis on an electromagnetic basis is one of the most important results contributed by Lorentz to optical theory. The explanation of the result of the Michelson-Morley experiment and of the double refraction experiment by Lord Rayleigh and Brace, forms most interesting reading. The hypothesis of a contracted electron is introduced, and with it the question of electric inertia is again raised. The chapter closes with an exposition of Einstein's principle of relativity.

The book is a most fascinating one, and to those acquainted with Lorentz' former memoirs, it is unnecessary to say that it is written with a lucidity that characterises a master hand.

We venture to offer some observations on the view that negative electrons possess an inertia which is entirely of electric origin. It appears to us that the proof requires considerably more support, both on the experimental and on the theoretical side, than it has yet received.

For many purposes it is unnecessary to define an electron further than to say that it possesses a charge. But when we come to the question of inertia we have to define the size and shape of the electron. Surface conditions are, of course, determined by the fundamental equations. We confine attention to the two cases considered by Lorentz, viz., the "rigidly" electrified sphere of Abraham and the contracted electron of Lorentz. It has been claimed that Kaufmann's experiments agree with the spherical electron formula and the view that the ordinary inertia is *nil*. As a matter of fact, his experiments agree very much better with the contracted electron formula, but make the ordinary inertia quite comparable with the electric inertia for slow speeds. Bucherer's experiments also agree with the contracted electron formula, and make the ordinary inertia *nil*, but the speed was not so high as in Kaufmann's experiments. On the theoretical side it must be remembered that both formulæ are derived from the energy of the steady state, using the "quasi-stationary state" principle. This principle has been acknowledged as quite unsound, and it must in general lead to false results, when, as in the present case, any change of velocity is attended with radiation into the medium. We have reason to believe that any change of velocity is accompanied by a redistribution of the charge on the electron, and this in general leads to an expression for the inertia which differs from that obtained by differentiating the energy of the steady state.

We may well hesitate to sweep away the last scrap of ordinary matter from an electron until the proof rests on some principle more convincing than that of the quasi-stationary state.

OUR BOOK SHELF.

Handbook of Marks on Pottery and Porcelain. By W. Burton and R. L. Hobson. Pp. xii+210. (London: Macmillan and Co., Ltd., 1909.) Price 7*s*. 6*d*. net.

This volume supplies a distinct want. Mr. Burton is a practical potter, and the author of numerous works on the history of pottery and porcelain. Mr. Hobson is on the British Museum staff, and there are few men with greater chances of seeing and studying examples of all periods of pottery. The authors, therefore, speak with authority on subjects connected with ceramics, and although they style it a "reliable pocket volume," it is really a valuable and interesting addition to the bookshelves of collectors and students of pottery. Thousands of authentic marks will, of course, not be found in the volume, but those chosen are, on the whole, thoroughly representative, and the elaborate indices make the work of reference easy.

It is interesting to note the influence that one factory had on another, as shown by the marks. The Meissen factory was the father of European porcelain. The Cross Swords from the arms of Saxony, which was used there as their mark, can be seen in Caughley Tournay, Worcester, Derby, and Bristol. Even Meissen itself had in its early days, like so many other factories, marks in imitation of the oriental.

The short descriptions and the introduction are models of Precis writing, giving in a page or two the history of potting in each country. There is a little confusion in the use of the terms "hard and soft." Hard paste is fired at a high temperature, and the glaze is fired at the heat at which the porcelain matures. Soft paste, on the other hand, is fired at a lower temperature, and the glaze at a still lower one. The terms hard and soft have nothing to do with the hardness and softness, as usually understood. So far as the body of the piece of ware is concerned, some hard paste may scratch with a file more easily than soft.

The Oriental section is particularly good. It displays very great care, and is a decided advance on anything of a similar kind that has been within the reach of an ordinary collector.

The scheme of the work takes the reader through the various countries, and the period covered extends from the Middle Ages to about 1850, with a selection of modern marks. It is a very great advantage to have the authors' assurance that none but undoubted marks are illustrated in the volume. Great care seem to have been taken with the dates also, but on page 33 the A. R., the cipher of Augustus of Poland, the patron of Bottger, is given by the author as 1725–40. Most authorities, and with reason, place this mark considerably earlier.

The Races of Man and their Distribution. By Dr. A. C. Haddon, F.R.S. Pp. x+126. (London: Milner and Company, Ltd., n.d.) Price 1*s*. net.

This book gives a description of the various races of mankind as complete as appears to be possible within the compass of a small volume. The physical characters and culture of each race are described as far as it is at present known, and the author has in many cases to confess that the knowledge is, as yet, very incomplete. In the general classification of mankind the character of the hair is taken as a primary feature. The three great divisions of mankind obtained in this way are subdivided according to stature or the shape of the head. Whether this is the ideal method of classification or not, it serves as a basis for the orderly description of the various known races. The description of the supernatural beliefs, weapons, houses, &c., of the Oceanic peoples is especially full and complete.

The latest views on the African races and their relations to each other are clearly set out. The native races of Asia are described, though an unduly large proportion of the treatise appears to be devoted to Indian races. The description of European races is comparatively superficial. So little appears to be known about the physical characters of the native races of the American continent that the author adopts a geographical classification, which makes it somewhat difficult to realise the physical relations of these races to each other. Some of Dr. Haddon's views on the relations of races to each other would be disputed by the latest authorities; for example, the view that the Tasmanians belonged to the same race as the Papuans would hardly, we think, be accepted by Prof. Sollas.

There are ten plates of representative members of leading races, and a very useful glossary of ethnological terms at the end of the book. The value of the book to a beginner in ethnology would have been considerably enhanced if it had contained a few maps. This little book is a welcome contribution to anthropological literature, and contains much valuable and accurate information not otherwise easily accessible.

(1) *Der menschliche Organismus und seine Gesunderhaltung.* By Dr. A. Menzer. Pp. 159. (Leipzig: Quelle and Meyer, 1909.) Price 1.25 marks.
(2) *Unsere Sinnesorgane und ihre Funktion.* By Dr. E. Mangold. Pp. vii+147. (Leipzig: Quelle and Meyer, 1909.) Price 1.25 marks.
(3) *Die moderne Chirurgie für gebildete Laien.* By Dr. H. Tillmanns. Pp. iv+156. (Leipzig: Quelle and Meyer, 1908.) Price 1.25 marks.
(4) *Die Geschlechtskrankheiten, ihr Wesen, ihre Verbreitung, Bekämpfung und Verhütung.* By Prof. Schumburg. Pp. vi+102. (Leipzig: B. G. Teubner, 1909.) Price 1.25 marks.

THESE four little books are examples belonging to two series of publications, which embrace a number of works on religion, philosophy, literature, art, history, geography, science, &c. They give a clear, concise and popular exposition of the various subjects with which they deal. From our insular standpoint in some instances certain subjects are discussed in a more open manner than we are accustomed to.

In the first book on the list, after a brief description of the anatomy, histology, and physiology of man, the various subjects of the causation of disease, infectious diseases, clothing, food, and general hygiene are simply and adequately described.

In the second book, the various organs of the special senses, sight, hearing, smell, taste, and touch, are described, and the mechanism of their action, so far as is known, is detailed. In "Modern Surgery" the reader is introduced to surgical theory and practice as regards the Röntgen rays, anæsthesia, arrest of hæmorrhage, sterilisation and antiseptics, preparation for operation, microorganisms, and their relation to disease, inflammation, burns, wounds, cancer, &c. The book would form an excellent little text-book for nurses.

The fourth book deals in a very outspoken manner with the subject of venereal diseases, their consequences, spread, and prevention. The diseases are briefly described, the various measures of prevention detailed, and the social evils of prostitution and their remedy are discussed. We should consider it hardly advisable to place such a book in the hands of the general educated public, unless the reader had actual need to study the question with which it deals. All the books are clearly printed and freely and adequately illustrated.

R. T. H.

Plant Galls of Great Britain. A Nature-Study Handbook. By Edward T. Connold. Pp. xii+292. (London: Adlard and Son, 1909.)

THIS volume will certainly prove to be of great use to all students of insect and plant life. The author's previous works, viz., "British Vegetable Galls," published in 1901, and "British Oak Galls," published in 1908, are already well known. The present book is intended for the pocket as a guide in the field to botanists and collectors. The descriptions are condensed and brief, but Mr. Connold has not forgotten the value of good illustrations, and each description is accompanied by an excellent and typical photograph of the gall described. As the author points out, the systematic study of all British plant galls is as yet by no means complete. The subject offers a wide and interesting field for further research. This volume is well adapted to create an interest in these interesting vegetable structures, and to encourage the beginner to pursue his studies further.

The opening chapters give ample directions as regards the time when, the place where, and the manner how, to collect and study the various galls. The gall-producers, their habits and the principles of gall formation, are also adequately dealt with.

The list of English and Latin names of the host plants mentioned in the volume will be found of great use in the field. The various nomenclatures are becoming a vexed question, and a useful list of synonyms of gall producers has, therefore, been included, and at the end a very full index is given. The book cannot fail to serve its purpose as a field companion for the practical student of nature.

The Rhodesian Miner's Handbook. By F. P. Mennell. Second edition. Illustrated. Pp. 167. (Buluwayo: Ellis Allen, 1909.) Price 5*s*.

THIS is the latest of a series of books issued from the Rhodesia Museum. They are presumably intended to interest and instruct the settlers in the country, and to promote the prosperity of the industries of Rhodesia. Looked at in this light it may be that the book under review was well worth producing, and will be useful to its readers, but it is of little interest except to a prospector who has had no scientific training. It contains chapters of an elementary character on geology, mineralogy, ore deposits, prospecting, &c., and a quantity of miscellaneous information as to the present condition of the mining industry in Rhodesia. This is divided into sections, under the heads of precious metals, base metals, precious stones, and coal. The relative importance of the industries is indicated by the fact that in 1907 the gold represented nearly 94 per cent. of the total mineral production, and amounted in value to 14*l* 15*s*. per head of the white population, as compared, for example, with about 100*l*. per head in the Transvaal, and 26*l*. per head in Western Australia.

Los Métodos de Integracion. By Carlos Wargny. Pp. 234. (Santiago de Chile: Cervantes, 1907.)

IT is interesting to find that Spanish students in Chile study the integral calculus: otherwise this compilation calls for no special remark. It contains a collection of elementary examples of indefinite integration, many of which are worked out in elaborate detail. On pp. 128–9 Gregory's series and the expansion of arc sin x are given, without proper indication of the limits of the integrals from which they are derived.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Temperature of the Upper Part of Clouds.

AT the recent meeting of the British Association, a report of which appeared in NATURE of October 14 (p. 473), Prof. A. L. Rotch gave an account of the highest balloon ascent in America. It is stated he found the remarkable result that on at least two ascents the temperature increased in a cumulus cloud in passing upwards. It is stated that during the discussion of the paper doubt was expressed as to the reality of the phenomenon. The first thing that strikes one on reading Prof. Rotch's result is that it seems rather curious that this phenomenon had not been recorded in previous ascents. When one considers the conditions, it is only what might be expected. The upper part of the cloud is receiving and dealing with the whole solar radiation falling on its surface, as none of it passes through it. Some of this heat penetrates some distance into the cloud, where it undergoes repeated reflections from the cloud particles. One would thus expect that the cloud particles and the saturated air would absorb some of the heat and have their temperature raised, though probably the greater part of the heat is reflected into space.

There is, however, a point to which I wish to direct attention, and that is to the extreme difficulty of getting anything like correct records of temperature and humidity in the conditions existing at the top of cumulus clouds. On one occasion, while making observations on Pilatus Kulm, the top of the mountain being at the time in dense cloud, but evidently near its upper limit, part of the observations consisted in taking readings of wet- and dry-bulb thermometers, but under the conditions it was found to be very difficult to get trustworthy results. All sorts of abnormal and contradictory readings were at first obtained, even to the wet-bulb reading higher than the dry. A few observations of the surroundings cleared up the difficulties. To begin with, one felt as if in an oven. Radiant heat streamed in from every direction, though no sun was visible, not even the direction of it. An examination of the surfaces of surrounding objects showed them to be in a very abnormal condition, though in the midst of dense cloud many of them were perfectly dry, not the usual dripping condition. The heat reflected from the cloud particles was absorbed by the surrounding objects, and their temperature raised far above the dew point. For instance, a thermometer placed on a large piece of wood showed a temperature of 60° F., while if hung up near it only rose to 48°.

Under the conditions the diffused radiation acted on all surfaces and raised their temperature, but, of course, did not raise them all to the same amount, large bodies, as is well known under these conditions, being much more highly heated than small ones. For instance, ordinary pins driven into a wooden post for hanging the thermometers on got wet, while the post was quite dry. All other freely exposed small objects were wet, and all large ones dry. It was while the thermometers were hung on the post that the wet bulb read higher than the dry, the reason being that the dry was not really dry, but had a film of water over it; and it was colder than the wet bulb, because it was a little smaller, and the wet had also the advantage of a better heat-absorbing surface in its muslin covering. The wet- and dry-bulb temperatures could only be obtained after they had been properly protected from all radiation. In ordinary cloud observations no such protection is required.

As bearing on the question of the heat absorbed by clouds, it may be mentioned that while the observations were being made on Pilatus Kulm the atmosphere was in a constant state of boil, so to speak. Vertical currents were constantly surging up on one side or the other, though there was no wind. These vertical currents were probably due to the disturbing effects of the absorbed heat, and they seem to suggest that this heated upper part of the cloud may explain the formation of those pillar-like clouds sometimes seen rising from sunlit cumulus by the hot part breaking away from the body of the cloud and rising high above it. JOHN AITKEN.

Ardenlea, Falkirk.

Lines of Force and Chemical Action of Light.

THE fact that carbon dioxide is dissociated at the low temperature of the surrounding medium, when green organs of plants are exposed to sunlight, has been often considered as somewhat paradoxical. Count Rumford was the first who tried to account for it by suggesting that this process takes place in spaces so small that the temperature produced by the absorption of light may approach the highest temperatures obtainable in our laboratories. More recently I tried to adduce in support of this ingenious interpretation some considerations, derived from the experimental study of the actual conditions of this photochemical process.[1] Still more wonderful is the possibility of its going on, though very slowly, in diffused sunlight. But perhaps in the whole range of photo-chemical phenomena there is no fact more wonderful than the possibility of obtaining photographs of the remotest star or nebula.

All these photo-chemical riddles seem to me to find their full explanation in Sir Joseph Thomson's theory,[2] so eloquently expressed in his recent presidential address to the British Association at Winnipeg.[3]

If "a wave of light may be regarded as made of groups of lines of electric force," if "in the wave front there cannot be uniformity," and "it must be more analogous to bright specks on a dark ground than to a uniformly illuminated surface," then it becomes evident that the chemical effect of light on a single molecule cannot fall off in the same ratio as the dispersion of light in space. A single molecule lying in the path of a line of force may be, with regard to the distant sun or star, in the same condition as another molecule in the nearest proximity of these centres of energy. It will be only the number of molecules attacked that will be reduced with the increasing divergence of the lines of force, and this result can be compensated by prolonging the exposition. It seems to me that Sir Joseph Thomson's theory furnishes for the first time a real explanation for the fact that a ray of light is not deprived of its photo-chemical efficiency, no matter how great the distance between the source of energy and the molecule acted upon.[4] These considerations may give us perhaps a deeper insight into the part played by radiant energy in the chemistry of the universe than we possess until now.

A full discussion of the problem would require, of course, something more than the very modest scientific equipment of a botanist, and I should be very grateful if a more competent reader of NATURE would find it worth while to decide the question whether the conclusions here deduced are really consistent with Sir Joseph Thomson's theory.

University, Moscow. C. TIMIRIAZEFF.

The Position of the Radio-active Elements in the Periodic Table.

MANY arrangements have been suggested, which include the radio-active elements in the periodic table. So far as I am aware, these have all attempted to confine each space in the table to a single element. This restriction has led to unlikely assumptions, on account of the large number of these elements, and the limited number of spaces vacant preceding uranium.

From analogy with organic compounds it seems possible that different internal structures of the atoms of the heavier elements may exist, resulting in elements of the same weight with perhaps very different properties. Similarly, elements with very nearly the same weight might possess very similar properties. This would allow the truth of the following table, in which only three assumptions are made.

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[1] In my Croonian lecture on "The Cosmical Function of the Green Plant" (Proc. Roy. Soc., vol. lxxii., p. 454).

[2] "Electricity and Matter." (1903.)

[3] NATURE, August 26, p. 253.

[4] For instance, it seems to me that the following lines, though referring to photo-electric, may be as well applied to photo-chemical phenomena: ". . . thus any effect which can be produced by a unit by itself will, when the source of light is removed to a greater distance, take place, less frequently it is true, but when it takes place it will be of the same character as when the intensity of light was stronger." Sir Joseph Thomson, "On the Ionisation of Gases by Ultra-violet Light, &c." (Proceedings of the Cambridge Philosophical Society, vol. xiv., part iv., p. 421).

(1) It is possible that two elements of nearly the same atomic weight may occupy the same place in the table.

(2) The emission of an α-particle is accompanied by the production of an element which occupies the adjacent space of lower atomic weight.

(3) The emission of a β-particle, or a rayless change, may or may not be accompanied by a remove to a space of lower atomic weight.

In the table the elements which emit α-particles are printed in thick type, the other radio-active elements in italics.

								H 1
He 4	Li 7	Be 9	B 11	C 12	N 14	O 16	F 19	
Ne 20	Na 23	Mg 24	Al 27	Si 28	P 31	S 32	Cl 35·5	
Ar 40	*K* 39	Ca 40	Sc 44	Ti 48	V 51	Cr 52	Mn 55	Fe Co Ni 56 59 59
	Cu 64	Zn 65	Ga 70	Ge 72	As 75	Se 79	Br 80	
Kr 83	*Rb* 85·5	Sr 88	Y 89	Zr 90	Ch 93·5	Mo 96	Np? 100?	Ru Rh Pd 102 103 107
	Ag 108	Cd 112	Am 115	Sn 119	Sb 120	Te 127·5	I 127	
X 131	Cs 133	Ba 137	La 139	Ce, &c. 140–178	Ta 181	W 184		Os Ir Pt 191 193 195
	Au 197	Hg 200	Tl 204		Bi 208	? ← *Act C* ← **Th C**	← **Act B** ← *A* ← **Th B** ← *A*	
				Pb 207	← **RaF** ← E_2 ← E_1 ← *D*	← **Ra C** ← *RaB*	← **RaA**	
← **Act Em** ← **Th Em**	← **ActX′** ← ← **ThX** ←	**Radio-Act** ← **Radio-Th** ←	*Act* *Mesoth.2* ← *1* ←	**Th** 232·5				
← **Ra Em**	←	**Ra** ← 226·5	**Ionium** ←	*UrX*	← **Radio-Ur ?**	**Ur** 238·5		

In considering this table, if we assume that Rutherford and Soddy's theory, that the loss of an α-particle is accompanied by a corresponding decrease of 4 in the atomic weight, is correct, it seems certainly necessary to confine radium and radio-thorium to the same space in the table. They are both members of the barium series. The atomic weight of radium is 226·5, while that of radio-thorium must be (232·5−4)=228·5. Similarly the thorium and radium emanations resemble each other so closely that it is legitimate to suppose that they occupy the same space. They condense at almost the same temperature, while their rates of diffusion into other gases are very nearly the same. If one case is admitted, the whole is rendered probable. The evidence with the actinium series is not so positive, but the present arrangement satisfies the known facts.

It may be pointed out that there are three α-emitting elements between radium emanation and lead, and only three spaces in the table, and two α-emitting elements between thorium emanation and bismuth, with two spaces corresponding; lead and bismuth were suggested by Rutherford and Boltwood as the respective end-products of these series. Again, it may be emphasised that the anomalous existence of the group of rare earth metals, giving a difference of more than 40 in the atomic weight of the elements which precede and follow them, explains the change of the difference between two elements of a vertical series from about 46 to nearly twice that figure, so that no element of the argon series is to be expected between xenon and one with a weight about 220. *Except in the two spaces in the vertical series below manganese*, and possibly in the rare earth series, *there is no vacant space in the periodic table between hydrogen and uranium.* In this connection it is interesting to recall the suggestion of R. W. Wood (Astrophys. Journ., 1908, vol. xxviii., p. 75), that the green line in the spectrum of the sun's corona is the fluorescent line of some common element, and that the supposed element "coronium" of weight less than hydrogen does not exist.

It is possible that other β-emitting or rayless elements may be discovered. How far these are really *elements* depends, of course, on the *specific* physical and chemical properties they possess. These are often none too well defined. The mechanism of a rayless change, or one accompanied by the emission of a β-particle, may be compared with a change of frequent occurrence with organic compounds, the formation of one desmotropic substance from another under the influence of heat.

It must be remembered that should the conclusions be correct which are drawn from the recent work of Ramsay and Gray on the boiling point and critical constants of radium emanation, and should the atomic weight of 176 be confirmed, not only are the above arguments invalidated, but the whole theory of disintegration put forward by Rutherford and Soddy will require modification.

University College, London. A. T. CAMERON.

Radio-activity and the Rocks.

IN the course of some observations which I have recently made with regard to the pleochroic halos sometimes seen round inclusions in various rock-forming minerals, certain points have suggested themselves as possibly of considerable significance. It may be premised that Prof. Joly's suggestion that the halos are due to the α rays emitted by radium appears fully borne out by their remarkable constancy in size and by the fact that they are invariably connected with minerals independently known to be strongly radio-active, that is, comparatively speaking. The only qualification that need be made respecting this view is with regard to the possibility of radio-active substances other than radium producing the observed effects.

So far as my experience goes, the following minerals are capable of producing halos when enclosed in suitable substances like biotite, cordierite, hornblende, tourmaline, &c., zircon, orthite (allanite), epidote, sphene, and apatite. All these are silicates, except apatite, which is a phosphate. The last three are lime compounds, which does not, however, seem to be of any particular import. Zircon contains zirconium, orthite cerium and its allies, and sphene titanium, and it may be noted that orthite always contains thorium in some quantity, while both zircon and sphene may be expected, from a mineralogical point of view, to contain that element as an impurity. Epidote, being isomorphous with orthite, and frequently intergrown with it in rocks, the presence of some traces of thorium may also be generally presumed. As regards apatite, it is obviously significant that the other two phosphates which occasionally occur as rock-formers, namely, monazite and xenotime, always contain thorium in considerable amount; indeed, monazite owes its commercial value to the constant presence of that element. It would appear, therefore, as if the radio-activity of all the minerals cited might, unless other considerations are opposed to the idea, be fairly attributed to the presence of thorium.

There is, however, another feature of these minerals which may be of significance. It will be noticed that one or other of them contains all the elements grouped under carbon in series four of the periodic table, namely, titanium, zirconium, cerium, and thorium. Indeed, "carbonaceous matter" is itself recorded by Prof. Rosenbusch ("Rock-making Minerals," p. 197) as giving rise to pleochroic halos in andalusite. Of course, this might imply nothing more than that chemical similarity leads to similar impurities (*e.g.* thorium), to which the radioactivity may be due. It is not easy to see how such an explanation would fit the case of carbon, but otherwise it would readily account for the fact that halos are not always seen round the minerals mentioned above, and that they may occur round some crystals and yet not round others in the same rock. They are most common, indeed practically constant, round zircon and orthite, but are confined to a few occurrences of the abundant minerals sphene, apatite, and epidote.

Another point which seems to deserve emphasis is the fact that, from a geological point of view, the radioactivity of thorium must surely be a far more potent factor than that of uranium and its derivatives. For there is no mineral which occurs in ordinary rocks which appears to contain uranium in quantities appreciable by chemical methods, whereas, as will be inferred from what has been already said, thorium is of extremely wide distribution.

F. P. MENNELL.

Bulawayo, Rhodesia, October 18.

Magnetic Storms.

IN his letter (NATURE, November 11) Dr. Simpson raises an argument as to the absence of corresponding changes in the electrical potential gradient during magnetic storms which, if admitted, would, I imagine, prove a serious difficulty in the "electron stream" theory of magnetic disturbances. On the assumption that the arriving stream induces an opposite charge which resides at the earth's surface, we can agree with Dr. Simpson's calculation, except that, since there are two current sheets of opposite sign, the potential gradient ought to be half what he finds.

It seems to me most unlikely that the induced charge resides at the earth's surface. The atmosphere is slightly conducting, and it is throughout it that the induced charge distributes itself. It is well known that a very slightly conducting shell will with great rapidity act as a perfect electrostatic screen, but, on the contrary, fails to screen magnetic effects. In his paper (Phil. Trans., A, 1908) on terrestrial magnetism, Dr. Schuster points out that the normal conductivity of air at the earth's surface is about 10^{-24}, while at a height such that the pressure is 1 dyne per sq. cm. the conductivity would be about 10^{-18}. For such a conductivity the time constant of decay would be about 10^{-4} of a second, or, in other words, practically complete electrostatic screening would be established in about one-thousandth part of a second, and correspondingly the slight initial magnetic screening would then cease. We have thus a simple explanation of the absence of direct electrostatic effects at the surface of the earth due to "electron streams" several hundred kilometres above the earth. The earth currents which do accompany magnetic storms are thus referred, not to electrostatic induction, but to change of magnetic induction at the earth's surface.

GEORGE W. WALKER.

Eskdalemuir Magnetic Observatory, November 12.

The Photometric Measurement of the Obliquity Factor of Diffraction.

IN vol. lxxviii. of NATURE (May 21, 1908, p. 55) was published a note on "Secondary Waves of Light," in which I described the diffraction effects produced by an obliquely held rectangular aperture or reflecting surface, and pointed out that the observed distribution of illumination in the pattern was not in accordance with that deduced in the ordinary way. I indicated an explanation of the discrepancy, that it was due to the variation of the obliquity factor of diffraction within the limits of the pattern.

The interest of the observations lay in the fact that such an effect had never been noticed before, and that the observations enabled us actually to trace the variation of the amplitude of vibration from point to point on Huygens's secondary waves. A full description of the effect and a mathematical investigation were published in the *Philosophical Magazine* for January.

The effect observed was that the intensities of illumination in corresponding bands on opposite sides of the central band in the unsymmetrical pattern were unequal. A photometric investigation of this difference in illumination has been carried out. The method was to use revolving sectors to reduce the illumination in one of the two bands to be compared, so as to make them both of equal brightness. The following table illustrates the comparisons made:—

No. of expt.	Ratio of illumination according to ordinary theory	Ratio of illumination actually determined	Ratio of illumination calculated from obliquity
1	... 1·00	... 1·66	... 1·61
2	... 1·00	... 1·81	... 1·98
3	... 1·00	... 2·66	... 2·43
4	... 1·00	... 3·25	... 3·27

The obliquity law demonstrated by these measurements is that, in the hemispherical wavelets emitted by each element of a transmitting aperture or reflecting surface upon which waves are incident at any angle, the amplitude of the light vector is, at any point in the plane of incidence, proportional to the cosine of the angle made by the line joining that point and the element, with the normal to the plane of the element.

C. V. RAMAN.

Post-Box 59, Rangoon.

Mendelian Heredity: A Correction.

I SHOULD be glad of an opportunity of correcting the following errors in my book "Mendel's Principles of Heredity":—

On p. 35, Davenport's result regarding rumplessness in fowls is accidentally inverted. The character, according to him, is recessive, not dominant as stated by me. I have to thank Prof. Arnold Lang for this correction.

The other, and more serious, error is in the description of Fig. 34 of the second impression of the book (p. 231). In giving a tentative scheme for the descent of colour-blindness, I there stated that a male homozygous for colour-blindness could be produced by the mating of two colour-blind parents; but if the scheme is right, it evidently follows that such a male cannot be formed even from that mating.

W. BATESON.

November 12.

The Functions of the Martian Canals.

WITH reference to the recent paper by Dr. Pocklington before the Royal Society, on the functions of the Martian canals, a notice of which appeared in NATURE of November 11 (p. 58), I should like to suggest that these canals may perhaps be used for power-storage purposes. In Mars, possibly, there are seasons of winds or monsoons during which the upper reaches of the canals would be pumped full by innumerable windmills, and the power thus stored utilised during calm seasons, and transmitted electrically for lighting, heating, and general power purposes. For a population which had exhausted all its mineral fuel, which possessed no extensive ocean, and whose soil and climate were unsuitable for the growth of fuel, this would indeed appear to be the only means of obtaining heat and power. The same canals could serve the triple purposes of communication, power, and irrigation.

H. F. HUNT.

7 Officers' Row, Pembroke Dock, Wales,
November 13.

GRAVITY SURVEY.[1]

THE two publications described below afford a remarkable example of the value of an International Bureau worked in the right spirit and used in the right way. The sumptuous institute upon the Telegraphenberg at Potsdam is the home of the

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[1] "Survey of India: Professional Paper, No. 10. The Pendulum Operations in India, 1903–7." By Major G. P. Lenox-Conyngham, R.E.; with an appendix by A. Strahan, F.R.S. Pp. ix+196. (Dehra Dun, 1908.)

"Deutsche Südpolar Expedition, 1901–3." Band i., Geographie; Heft iii., Die Schwerkraftsbestimmungen der Deutschen Südpolar Expedition. By E. von Drygalski und L. Haasemann. Pp. 285–363. (Berlin: Georg Reimer, 1909.) Price 12.80 marks.

Prussian Geodetic Institute and of the Central Bureau of the International Geodetic Association. The same chief directs them both, and a visitor sees no obvious line of demarcation between the two. There is, however, no need to inquire minutely how much is Prussian and how much is international; the resources and experience of both are freely available when advice and cooperation are desired.

The last series of pendulum operations in India had been brought to a close in 1871 with the tragic death of Captain Basevi, who lost his life from exposure while working with the Royal Society pendulums at great altitudes in the Himalayas. When the Government of India resolved to undertake a new and more extensive series, they began by asking the advice of Prof. Helmert, chief of the Central Bureau. He recommended the use of half-second pendulums of the von Sterneck pattern, offered to obtain them from the makers in Vienna who had supplied the Potsdam instruments, and to standardise them at Potsdam. In 1902 Major Burrard and Captain Lenox-Conyngham went to Potsdam to study the use of the pendulums, and Prof. Haasemann, to whom the standardisation had been entrusted, gave up the whole of his time to their instruction. The pendulums were then swung at Kew and at Greenwich, were taken to India, and set to work; and, lastly, it was arranged that Dr. Hecker, of Potsdam, returning from his second "gravity-voyage," should join the Indian pendulum party wherever they might happen to be, and swing his Potsdam pendulums in India, to provide a final control of the circuit Potsdam—Kew—Dehra Dun—Potsdam.

The admirable results of this cooperation are visible on every page of Major Lenox-Conyngham's memoir. He started with an equipment already well tried. He could face the peculiar difficulties of Indian pendulum work with the confidence that he knew all about the ordinary troubles; and, by no means least, he can describe his work in a way which makes it perfectly easy to read in conjunction with German work, for they are written in the same language, though in a different tongue.

It is well known that an exceptional difficulty has embarrassed the survey of India for many years. How much does the enormous mass of the Himalayas and the Tibet plateau to the north, how much does the enormous deficiency of mass in the deep ocean to the south, affect the direction of gravity in India? India was the birthplace of Pratt's celebrated hypothesis of "compensation." The general principle, that an excess of matter above the sea-level is compensated by a deficiency of density below, has been established in the Caucasus and the Tyrol. The fact that gravity is normal, not deficient, over the deep oceans was strongly suggested by Faye when he showed that on solitary islands gravity is in excess by an amount corresponding to the mass of the island above the ocean floor; it has recently been established by Dr. Hecker's elegant application of Mohn's method—the comparison of the mercurial barometer and the boiling-point thermometer at sea.

Only in India has the establishment of the principle of compensation suffered a series of small reverses. Colonel Burrard's series of latitude determinations, published a few years ago, showed that a hidden chain of excessive density runs parallel to the Himalayas to the south, which very much complicates the situation. Major Lenox-Conyngham's pendulums confirm the existence of this chain, and bring to light a new feature—that between it and the Himalayas there is a "ditch" along which gravity is in defect; and, lastly, along the fringe of the mountains their attraction is by no means completely compensated. Five stations in the Himalayas and two in the Baluchistan hills were occupied. "At all these points a deficiency of density is revealed, but in no case does it amount to total compensation. . . . Under all the submontane and mountain stations there appears to be a deficiency which is nearly constant in amount, and is not proportional to the height of the station."

But these interesting results touch only the fringe of the Himalayas, and they are not to be taken as indicating a general failure of complete compensation for the mountain mass as a whole. Before this can be either affirmed or denied it will be necessary to get observations further north; and it is interesting to note that, as Major Lenox-Conyngham points out, it is more important to get well in among the mountains than to climb to excessive altitudes, where the conditions make accurate work almost impossible. Unfortunately, access to Tibet is forbidden to British subjects, including its own scientific servants, by the Indian Government; nor is it easy to disguise a pendulum equipment as a praying-wheel.

The technical details of modern pendulum work are highly interesting, in particular the correction for the flexure of the pendulum support. The present practice is a development of Captain Kater's method of the inverted pendulum initially at rest, which is set swinging by the motion of the stand. In its actual shape it is the invention of Prof. Schumann, of the Prussian Geodetic Institute. An auxiliary pendulum is mounted with its knife-edges parallel to those of one of the set; it has an adjustable weight on the bob by which the times of vibration can be made equal. If one is set swinging, the pull of its knife-edges on the agate plates will rock the stand and set the other swinging; over a considerable range the ratio of the amplitudes of the driven and the driving pendulum increases proportionally to the time, and a simple relation connects this ratio with the virtual increase in the length of the pendulum due to the flexure. It is thus a simple matter to determine the correction for flexure of the stand and pillar at each station, and a pretty illustration of the need of the correction is given by those series which were begun upon a concrete pillar newly cast, and show unmistakably the gradual stiffening of the pillar as the concrete hardened.

The pendulum observations are differential, and it is necessary to choose a base. Kew Observatory was selected, because it had been the base for the earlier Indian series, and the National Physical Laboratory gave valuable assistance in the observation of the base series and a re-determination of the constants of the pendulums for verification. At the suggestion of the Astronomer Royal, Greenwich was chosen as a secondary base. A remarkable feature of the report is the exhaustive appendix by Mr. A. Strahan on the geological strata underlying Kew and Greenwich, and their height above the "Palæozooic floor." With these refinements of observation and discussion the observed differences in the value of *g* at Kew and Greenwich become fairly accordant with the theoretical differences, and warrant the conclusion that "henceforward the pendulum may prove as satisfactory in practice as it has always been attractive in theory."

Dr. Drygalski's Antarctic expedition had the bad fortune to be frozen in just outside the Antarctic circle, and he was unable to reach Antarctic land. His pendulum operations were therefore confined to the island of Saint Vincent in the Cape Verdes, to Kerguelen Island, and to a station on the ice near the winter quarters of the *Gauss*. At the two former gravity was in excess, as is usual on oceanic islands; upon the ice it was nearly normal, which confirms the results of Dr. Hecker's recent determinations of gravity at sea. The observations on the ice were of the heroic order, from difficulty, not with the pendulums, but with the clocks. An ice pillar proved nearly as stable as concrete for the pendulums, but the chronometer stopped at a temperature of −35° C., and the clock was filled with snow in the rather inadequate observing hut. The clock was then removed to the ship and connected with the "flash box" by cable; but the ship heeled over in an Antarctic gale, and again the clock stopped. Finally, after six months' work, it was installed in an ice house, when it went creditably.

The discussion of the observations, largely due to Prof. Haasemann, is full of interest, but the interest lies, unfortunately, in the details of the struggle against adverse circumstances rather than in the wealth of results. It is much to be regretted that Dr. Drygalski's pendulums failed to reach land within the Antarctic circle, for it may be long before so complete an equipment and so accomplished an observer travels again to that sector of the Antarctic.

A. R. H.

A NEW OCEANOGRAPHICAL EXPEDITION.

THE *Times* of November 9 announces the organisation of an important expedition for the investigation of the eastern part of the North Atlantic Ocean, with a possible extension westward to Newfoundland. By an Order in Council, dated October 16, his Majesty the King of Norway has granted permission, subject to certain conditions, for the Norwegian Government steamer *Michael Sars* "to be placed gratuitously at disposal for a scientific expedition in the Atlantic Ocean from the Canary islands to the Færöes, in the spring of 1910, proposed by a British subject, Sir John Murray," and also for "the Fishery Director, Dr. Hjort, Assistant Koefoed, and Mr. Helland-Hansen, as well as the ship's captain and engineer . . . to take part in the expedition while continuing to draw their salaries."

The *Michael Sars* is to sail under the Norwegian flag during the expedition, which is to extend over not more than four months, and Sir John Murray has undertaken to pay all expenses not provided for by the Order in Council.

The chief purpose of the forthcoming expedition, which must necessarily contribute results of first-rate importance to the science of oceanography, is to apply the new instruments and methods of research developed during the last few years, more particularly by the International Council for the Study of the Sea, to the deeper regions of the open ocean. It is believed that the use of large nets and trawls is practicable in deep water, and that, should this prove to be the case, zoological discoveries of great interest and importance will be made. The application of methods of high precision to the determination of the temperature and salinity of sea water has yielded results which have raised considerable doubt in the minds of some investigators as to the validity of the earlier observations made by the *Challenger* and other expeditions, and the cruise of the *Michael Sars* should not only afford much entirely new information, but provide a means of valuing the earlier work. Specially valuable data may be expected from the use of Ekman's new current-meter, which makes it possible for the first time to obtain direct measurements of the currents in the depth.

THE REV. W. H. DALLINGER, F.R.S.

IN the history of "Protozoology"—a department which has advanced of late so rapidly that it has journals, laboratories, and professorial chairs devoted to it—an honoured place, in one of the earlier chapters, must be given to the late Dr. Dallinger, for to him and to his fellow-worker, the late Dr. Drysdale, we owe the first complete record of a complex Protistan life-history, and at the same time a fine example of careful investigation.

William Henry Dallinger was born in 1842 at Devonport. He entered the Wesleyan ministry in 1861, and travelled various circuits, much esteemed as an impressive and weighty preacher. A serious illness is said to have driven him from theology to biology, for in his convalescence he took up the study of open-air natural history, and became fascinated with microscopic work. In 1880 he was appointed principal of the Wesley College, Sheffield, but he resigned this position in 1888 to devote himself more exclusively to scientific work, the Wesleyan Conference allowing him to retain his status and prerogatives as a minister, though without pastoral charge or any other office. Dallinger did much effective work as a lecturer on the staff of the Gilchrist Educational Trust, and his popular lectures on such subjects as "The Infinitely Little," "An Hour with the Microscope," and "Spiders," were models of clear exposition. He had a vivid and careful style, and give his delighted audiences a sound mixture of accurate facts and suggestive ideas. A good instance was the lecture on "The Lowest and Smallest Forms of Life," which he delivered on the occasion of the Montreal meeting of the British Association in 1884. For many years Dr. Dallinger was secretary of the Royal Microscopical Society, and he occupied the presidential chair from 1883 to 1887. He took a great interest in this society and in its valuable journal. It is said that during his presidency he travelled to attend the meetings a distance equal to about half the circumference of the globe, and it was characteristic of his conscientiousness that he usually journeyed back from London to Sheffield by the early mail train so as to be in time for his college duties in the morning.

Dallinger's scientific work began about 1870, and in 1873-6 he published, along with Drysdale, a series of papers on the life-history of monads in the *Monthly Microscopical Journal*. The characteristic feature of the patient labours of the two friends was continuity of observation. By means of a delicate mechanical stage and other devices they were able to keep their eye on one particular specimen of *Bodo saltans*, or whatever the flagellate might be, and follow it from phase to phase. By using a binocular they were able to change places without losing sight of the particular creature the life-cycle of which was being traced. On one occasion Dr. Dallinger kept up continuous observation for nine hours. The result was that some complete life-histories were worked out—spore-formation, growth of spores into flagellates, repeated fission of flagellates, conjugation, encysting, and spore-formation again. This was interesting in itself, it was prophetic of much that has followed in recent years, and it exposed one of the pitfalls in which believers in present-day abiogenesis are apt to come to grief.

In connection with the spontaneous generation question—which has had so many fruitful results—Drysdale and Dallinger made some interesting studies, showing, for instance, that although boiling the water killed monads in an active condition, it did not kill the spores. For the spores, indeed, the fatal temperature is very much higher, up to 268° F.

in water, up to 300° F. or more when dry. This led on to one of Dallinger's best known researches (Proc. Roy. Soc., xxvii., 1878), in which he showed that flagellates could gradually adapt themselves to tolerate extremely high temperatures. Starting with a medium at 60° F., in which three selected species (*e.g. Dallingeria Drysdalei*) flourished, he very gradually raised the temperature to 158° F., without killing off the organisms. That scalding heat would, indeed, have been fatal to the original stocks, but there had been, of course, myriads of generations, and the power of resistance to heat had been gradually augmented. The adapted forms showed marked vacuolation. Dallinger seems to have thought that this was a case of the inheritance of "acquired characters," but it is obviously out with Weismann's category of "somatic modifications." It is interesting to recall that Darwin was much interested in Dallinger's experiment because of its bearing on the adaptation of living creatures to hot springs. He wrote:—"The fact which you mention about their being adapted to certain temperatures, but becoming gradually accustomed to much higher ones, is very remarkable. It explains the existence of algæ in hot springs."

So far as we know, Dallinger's microscopical studies did not extend beyond monads and the like except by way of recreation, and his output of work was not great. It was thorough, however, as the man himself, and the lesson of his patience has still to be learned by some of the too impetuous workers of to-day. In 1886 he published the "Fernley Lecture" on "The Creator, and What we may Know about Creation," and he wrote many scientific articles for the *Wesleyan Methodist Magazine*. He wrote also a number of papers on spontaneous generation and heterogenesis, both of which he profoundly disbelieved in, on the ultimate limit of microscopic vision and kindred questions, and on the thermal death-point of microbes. A characteristic deliverance was an address to the Literary and Philosophical Society in Liverpool entitled "Life-histories and their Lessons: a Defence of the Uniformity and Stability of Vital Processes as Controlled by the Laws of Evolution." But his *magnum opus*, apart from monads, was his edition and re-edition (1891 and 1901) of "Carpenter's Microscope," which he brought up to date, and with the aid of specialists developed into a most valuable encyclopædia of the whole science and art of microscopy.

Dallinger was elected a Fellow of the Royal Society in 1880, and he received the honorary degrees of LL.D. from Victoria University in 1884, of D.Sc. from Dublin in 1892, of D.C.L. from Durham in 1896. He enjoyed the respect and esteem of scientific workers, and he has left his successors a pattern of thoroughness, patience, and enthusiasm.

THE STUDY OF GERMAN IN SCHOOLS.

TWELVE months ago an influentially signed letter, dealing with the study of German in secondary schools, was sent to the President of the Board of Education. That letter pointed out the serious neglect into which the study of the German language is falling in secondary schools, and urged the Board to take steps to encourage and foster the teaching of German. It was made clear that the decline of German as a secondary-school subject is a matter of grave national importance from the points of view of general literary culture, the public services, practical utility, and of rendering a good understanding between the peoples of two great nations less easy.

About six months after the receipt of this letter, the Board of Education issued a memorandum (circular 705) on language-teaching in State-aided secondary schools in England, in which an optimistic view of the condition of German teaching in England was taken, and it appeared to be argued that an advance was in progress in the number of pupils studying the language.

The various associations interested in the teaching of modern languages have had the Board's circular in particular, and the whole question generally, under consideration again, and a second letter has been sent to the President of the Board of Education, signed by representatives of the Modern Language Association, the Society of University Teachers, the Teachers' Guild of Great Britain and Ireland, and the British Science Guild.

The letter conveys the sense of disappointment of the associations generally with the "Memorandum on Language Teaching in Secondary Schools in England" (circular 705), and dissents in particular from several of the doctrines and statements laid down in it. It appears that

> The Board of Education has not obtained, and cannot obtain, the materials required for making the return on the time allotted to modern language teaching in schools in the exact form that the motion in the House of Lords made on February 5, 1908, demanded, but there seems no good reason why the Board should not furnish Parliament and the public, in whatever shape it thought good, with the information suggested by the motion. What we desire to know, and what the Board has full power and opportunity for ascertaining, is the present condition of modern language teaching in secondary schools, the place assigned to it in the curriculum by headmasters and governing bodies, the relation in which it stands to the teaching of Classics and of English, the qualifications, emoluments, and status of its teachers. On these points the memorandum throws no light.

The remark in the Board's memorandum that "the advance in the study of German is not at the present moment as rapid as the advance in the study of French, or even of Latin," scarcely represents the facts. All the evidence available shows that, not only has there been no advance in the study of German, but rather a rapid and decided retrogression. Sympathetic action is required to arrest this decline.

The letter continues:—

> As regards the contention that "the curriculum of schools is necessarily guided by the course of the Universities to which it is to lead," we would observe that only a fraction of the pupils in State-aided schools proceed to the university, and no curriculum can be deemed satisfactory which does not satisfy the needs of the bulk of the scholars. The majority of the pupils in these schools leave school before the age of seventeen, and it is allowed that for such pupils, "both practically and educationally, German is a language of the first importance"; yet the Board throws the whole weight of its influence into the scale of Latin as against German, apparently out of consideration for the one boy in a hundred who will go on to the university; and in this case what would be confessedly good for the many would be no less good for the favoured few. The number at Oxford and Cambridge taking medicine, science, and modern subjects is rapidly on the increase, and it is a constant cause of complaint among the professors and teachers of these subjects that their pupils come to them heavily handicapped by their ignorance of German. It is hardly necessary to insist on the value of a knowledge of German to honour students in every faculty.
>
> Our suggestion that the Board should encourage and foster schools of the type of the German Realschule and Ober-Realschule is not noticed, but it is indirectly negatived by the insistence on Latin as one of two foreign languages where two are taught.

We would reiterate our conviction that a sound and thorough literary training can be given through English, German, and French without a knowledge of Latin. If, in the words of the memorandum, English can serve as "the backbone of a humanistic education," surely a combination of English, German, and French would constitute a valuable type of humanistic education.

We greatly regret that the Board has not, as yet, seen its way to lead public opinion on so vital a matter as the study of modern languages, and we express a hope that the memorandum is not its last word.

NOTES.

THE following is a list of those to whom the Royal Society has this year awarded medals. The awards of the Royal medals have received the King's gracious approval:—the Copley medal to Dr. G. W. Hill, For.Mem.R.S., for his researches in mathematical astronomy; a Royal medal to Prof. A. E. H. Love, F.R.S., for his researches in the theory of elasticity and cognate subjects; a Royal medal to Major Ronald Ross, F.R.S., for his researches in connection with malaria; the Davy medal to Sir James Dewar, F.R.S., for his researches at low temperatures; and the Hughes medal to Dr. R. T. Glazebrook, F.R.S., for his researches on electrical standards.

WE regret to see the announcement of the death, on November 12, of Dr. W. J. Russell, F.R.S., in his eightieth year.

THE death is announced, at sixty-six years of age, of Sir William Thomson, C.B., honorary surgeon to the King in Ireland, and the author of several publications on surgical subjects.

SIR T. H. HOLLAND, K.C.I.E., F.R.S., professor of geology and mineralogy in the Manchester University, will deliver the Wilde lecture of the Manchester Literary and Philosophical Society for 1910.

THE death is announced, on November 13, of Dr. C. Graham, formerly professor of chemical technology at University College, London, at seventy-four years of age. Dr. Graham was a vice-president of the Institute of Chemistry in the years 1882–4, and served on the council for several years.

THE specimens illustrating the manufacture of high-class lenses, shown by Messrs. J. H. Dallmeyer, Ltd., at the Franco-British Exhibition last year and the Imperial International Exhibition this year, have been presented to the Board of Education. This collection, which was awarded a Grand Prix, is now housed in the western galleries of the Science Museum, South Kensington.

AT the annual general meeting of the Cambridge Philosophical Society on October 25, the following were elected officers of the society for the ensuing session, 1909–10:—*President*, Prof. Bateson; *vice-presidents*, Dr. Hobson, Dr. Fenton, Prof. Seward; *treasurer*, Prof. Newall; *secretaries*, Mr. A. E. Shipley, Dr. Barnes, Mr. A. Wood; *new members of the council*, Sir J. Larmor, Prof. Biffen, Prof. Pope, Mr. R. H. Rastall, and Mr. K. Lucas.

AT the annual general meeting of the London Mathematical Society on November 11 the following were elected as the council and officers for the session 1909–10:—*President*, Sir William Niven, K.C.B., F.R.S.; *vice-presidents*, Mr. A. Berry, Dr. W. Burnside, F.R.S., Major P. A. MacMahon, F.R.S.; *treasurer*, Sir Joseph Larmor, F.R.S.; *secretaries*, Dr. A. E. H. Love, F.R.S., Mr. J. H. Grace, F.R.S.; *other members of the council* (names of members not on the retiring council are in italics), Dr. H. F. Baker, F.R.S., Mr. G. T. Bennett, *Dr. T. J. I'A. Bromwich, F.R.S., Mr. E. Cunningham,* Mr. A. L. Dixon, Dr. L. N. G. Filon, Dr. E. W. Hobson, F.R.S., Mr. H. W. Richmond, and Mr. A. E. Western.

SIR ERNEST SHACKLETON was officially received by the Paris Geographical Society on Monday, November 15, in the Grand Amphitheatre of the Sorbonne, and gave an account of his Antarctic expedition. From the *Times* we learn that after the address Prince Roland Bonaparte, the president of the society, rose and said:—"Since its foundation in 1827 our Geographical Society, which is the *doyenne* of all similar societies, has always desired to recognise the labours of the most illustrious travellers by bestowing upon them its grand gold medal. Among those to whom it has been given were the Polar explorers Sir John Franklin, Sir James Clark, Ross, Dumont d'Urville, and Nansen. To the list of these great names the Geographical Society is happy to add yours by offering you its grand gold medal, which is the highest recompense that is in its power to bestow."

THE first session of the seventeenth International Congress of Americanists will be held in Buenos Ayres, Argentine Republic, on May 16–21, 1910. The general and sectional meetings will be held in the hall of the National University in Buenos Ayres. A second session will take place in Mexico in September of the same year. A commission of organisation has been formed, the president of which is Dr. José Nicolas Matienzo, dean of the faculty of philosophy and letters in the National University. Communications, which may be either oral or written, may be made in English, French, German, Italian, Portuguese, or Spanish. The conference will deal with questions relating to the ethnology, archæology, and history of the New World, and a detailed programme will be published towards the end of the present year. For further information application should be made to the general secretary of the committee of organisation, Dr. Lehmann-Nitsche, Calle Viamonte 430, Buenos Ayres.

THE annual report of the Liverpool Marine Biology Committee and the Port Erin Biological Station was submitted by Prof. Herdman at a meeting of the Liverpool Biological Society on November 12. In the course of his address Prof. Herdman gave an account of the work, both scientific and economic, carried out during the past year, such as the curator's report upon the hatching and setting free of more than seven millions of young plaice, making a total of $25\frac{1}{2}$ millions during the six years the hatching has been in operation; the experiments in lobster rearing; Dr. Ward's investigations on the eggs and young larvæ of the plaice (illustrated by many very beautiful enlarged photographs); Mr. Gravely's work on the development of the brittle-starfish; Dr. Herbert Roaf's researches on digestion in marine animals; Mr. Dakin's physico-chemical observations on the condition of the sea-water at different times in connection with the migrations of the food of fishes; Mr. Edwin Thompson's photomicrographs of various types of minute organisms in the sea; and Prof. Herdman's own investigations into the detailed distribution of life in the sea. Some of the biological stations and establishments for fish culture in Canada and the United States were also described, and attention was directed to the American system of providing dormitories and dining halls for the students and researchers, and to the manner in which men of wealth in the States advance science by making large donations to such laboratories in order to defray the expenses of special investigations or marine and other explorations.

DR. D. S. JORDAN, president of Stanford University, contributes to *Science* an appreciation of the work of Dr. Kakichi Mitsukuri, dean of the college of science in the Imperial University of Tokio, who died on September 16. Dr. Mitsukuri was the author of numerous papers on zoological subjects, and was largely responsible for the establishment of the seaside laboratory at Misaki, where much excellent work has been done by Japanese, as well as by American and European naturalists. Dr. Mitsukuri was born in Edo, Japan, on December 1, 1857. He went to America in 1873, and received the degree of Ph.D. in zoology from Yale University in 1879. Returning to Japan, he was appointed a professor of zoology, in 1882, in the science department of the University of Tokio. In 1883 he received the degree of Ph.D. in zoology from Johns Hopkins University. In 1893 he was appointed councillor of the Imperial University. In 1896 he was made head of a commission for the investigation of the fur seal, and in 1897 he signed on behalf of Japan a treaty whereby Japan agreed for a certain length of time to consent to any adjustment of this matter which might be made by Great Britain and the United States. Dr. Mitsukuri was made dean of the College of Science of the Imperial University of Tokio in 1901, and six years later was awarded the Order of the Sacred Treasure in recognition of his public services. Of late years Dr. Mitsukuri was engaged in the special study of the turtles, and was also largely occupied with matters of administration.

TWENTY-FOUR delegates, representing Great Britain, France, Germany, Austria-Hungary, Russia, Spain, United States, Canada, and Australia, met at the Foreign Office on Tuesday to consider the steps to be taken for constructing a map of the world on the scale of 1 : 1,000,000 (16 miles to the inch), on a uniform system. The conference was opened by Sir Charles Hardinge, Permanent Under-Secretary of State for Foreign Affairs. In opening the congress Sir Charles Hardinge summarised the history of the movement. The *Times* reports him to have said that it was in the year 1891 that the question of an international map was first raised at the International Geographical Congress at Berne. Two years later several distinguished German men of science met at Stuttgart, where the question was again seriously discussed, and upon that occasion Prof. Brudener contributed a very valuable report upon the subject. Two years later the matter was taken up by several geographical societies both in Paris and London, and it was fully discussed at a meeting of the Geographical Congress in London in 1895. In various countries the preparation of maps on the scale of 1 : 1,000,000 was then commenced. These maps were chiefly of Asia and Africa, and though uniform in size, sheets, and scale, were wanting in uniformity in other details. The next step of any importance took place in 1908, when it was proposed by the delegates of the United States of America, at the International Geographical Congress at Geneva, that an international map should be definitely standardised. This was agreed to by the members of the congress, and a system of detailed resolutions was universally voted by them. It was felt, however, that unofficial proceedings of this description had no positive result, and were somewhat of the nature of pious aspirations. It was considered necessary, therefore, that the Governments interested should invite official delegates to meet in conference and to arrive at an agreement, which they would be able to submit to their respective Governments for approval and adoption.

THE greater portion of the combined first to fifth parts of vol. xviii. of *Actes de la Société scientifique du Chili* is devoted to an article, by Mr. C. E. Porter, on myriopods, which concludes with a classified list of the known Chilian species.

IN order to obtain sufficient material for an inquiry as to the degree of variation in the wings of beetles of the family Carabidæ, Dr. Sharp asks in the November number of the *Entomologist's Monthly Magazine* for fresh and unmounted specimens of these insects. The inquiry, it is stated, promises to yield results of considerable interest.

AMONG other articles included in the August number of the Annals of the Transvaal Museum, attention may be directed to a check-list of the butterflies of the Transvaal, with notes on certain species, by Mr. C. J. Swiestra. The author has been enabled to raise the number of known species from the 238 or 239 (for both these numbers are mentioned), recorded by Mr. W. L. Distant in 1898, to 316.

IN the October number of the *Museums Journal* Mr. H. Bolton directs attention to a representative series of insects recently installed in the Bristol Museum with the object of displaying the essential features and character of the different orders and their mutual relations, while in a second article the same author emphasises the value and importance attaching to exhibits of injurious insects.

WE have to acknowledge the receipt of the *Scientific Monthly* for October, containing abbreviated reports of some of the presidential addresses at the Winnipeg meeting of the British Association; also of part i. of a catalogue of books on natural history offered for sale by Mr. Quaritch, of Grafton Street. This part includes scientific voyages and the publications of learned societies.

CONSIDERABLE interest attaches to the account, by Mr. C. W. Gilmore, of a new generic type (*Opisthias rarus*) of rhynchocephalian reptile from the Jurassic of Wyoming, published as No. 1698 (vol. xxxvii., pp. 35–42) of the Proceedings of the U.S. National Museum. The genus is established on the evidence of a left dentary bone of the lower jaw, which appears to approximate to the corresponding element in the existing Sphenodon and the Kimeridgian Homœosaurus. Opisthias is the first terrestrial rhynchocephalian hitherto obtained from American strata.

WE have received a copy of the report on the scientific investigations of the Northumberland Sea-fisheries Committee for 1908–9, from which it appears that additional trawlings have been conducted in order to standardise the previous results. A number of marked fish—notably a turbot, after four years—were recovered, while, out of 100 lobsters marked in 1907, thirty-six, none of which had migrated from their native grounds, were re-taken within nine months. An account of the marine laboratory opened at Cullercoats in 1908 is appended. The committee strongly recommends the establishment of a close time for crabs from October to January, during which period many of these crustaceans are changing their shells and out of condition.

TO Mr. W. B. Helland-Hansen, the author, we are indebted for a copy of a report on a recent statistical research into the biology of the cod and the haddock in the North Sea, published in vol. x. of "Rapports et Procès-verbaux du Conseil international pour l'Exploration de la Mer," 1909. The report is based on trawlings carried out to a great extent for the purpose of ascertaining the individual dimensions and weights of the haddock and cod frequenting the fishing-grounds at different seasons and in different years, in order to determine whether the grounds are being over-fished. The investigations are, however, only in a preliminary stage, and before they can be regarded as anything like complete will have to be extended so as to embrace surface-fishing at seasons when the cod are in pursuit of the shoals of herrings.

Our knowledge of Peruvian barnacles has been but slightly increased since the appearance of Darwin's monograph, and considerable interest attaches, therefore, to the report, by Dr. A. Pilsbry, published as No. 1700 of the Proceedings of the U.S. National Museum, on a collection recently made by Dr. R. E. Coker and Dr. W. H. Jones, of the U.S. Navy. The apparent absence of parasitic species or of forms commensural on crabs is a remarkable feature of the cirripede fauna of Peru. A new species of Balanus is described, and the opportunity has been taken to publish figures sufficiently large to exhibit the details of the plates of the previously known Peruvian forms.

In Bulletin No. 67 of the U.S. National Museum, comprising 135 pages of text and a large number of illustrations, Mr. Nathan Banks supplies entomologists with very full and detailed directions for collecting and preserving insects according to modern methods. A bulletin on the same subject, prepared under the direction of the late Dr. C. V. Riley, was published in 1892, but since that date new methods of collecting have been devised and studies are conducted on entirely new lines, so that it has been deemed advisable to re-write the pamphlet from beginning to end. Many notes on the preparation of insects for the cabinet have been copied from various entomological journals, while special information has been supplied in regard to particular groups by members of the Bureau of Entomology. The work commences with a general review of the different orders of insects and their developmental history, after which come directions for capture and preservation in the field and mounting and storing in the museum. Figures of apparatus of all kinds are given, accompanied by full descriptions of the cabinets employed in the U.S. Museum. The scope of the work likewise includes directions for rearing live insects and maintaining them in captivity, while the collection and preservation of spiders, scorpions, and centipedes also come within its purview.

A report by Dr. Newsholme and Sir Malcolm Morris, K.C.V.O., the British delegates to the International Conference on Leprosy held at Bergen in August last, has been issued as a Parliamentary Paper (Cd. 4916). They, together with several delegates from British colonies, formulated several resolutions for the control of the disease, the chief of which are as follows:—(1) Leprosy is spread by direct and indirect contagion from persons suffering from the disease. The possibility that indirect contagion may be effected by fleas, bugs, lice, the itch parasite, &c., has to be borne in mind. (2) Leprosy is not due to the eating of any particular food, such as fish. (3) There is no evidence that leprosy is hereditary. (4) In leprosy an interval of years may elapse between infection and the first recognised appearance of disease. (5) The danger of infection from leprous persons is greater when there is discharge from mucous membranes or from ulcerated surfaces. (6) Compulsory notification of every case of leprosy should be enforced. (7) The most important administrative measure is to separate the leprous from the non-leprous by segregation in settlements or asylums. (8) In settlements home life may be permitted under regulation by the responsible authorities.

A selection of new or noteworthy Philippine plants described by Mr. Merrill, forming the seventh series, is published in the *Philippine Journal of Science* (August). The majority of the determinations refer to tree specimens, and include new species of Diospyros and Cryptocarya, also additions to the families Meliaceæ and Flacourtiaceæ. In the latter family the author finds a similarity between Philippine and Ceylonese species. A new genus, Embolanthera, allied to Maingaya, is created in the Hamamelidaceæ, and Everettiodendron in the Euphorbiaceæ. A noteworthy new species is *Chonemorpha elastica*, an asclepiad, which promises to be the best native rubber-producing vine.

With the view of making the best use of their local museums, the Essex Museum of Natural History, Stratford, and the Epping Forest Museum, Chingford, the Essex Field Club held during the previous winter two conferences to discuss the use of museums for promoting nature-study in schools, which are reported in a small pamphlet recently published. At Stratford educational facilities are provided in the form of mounted specimens, drawings, and explanatory labels, while at Chingford the exhibition of seasonal plants and branches is made a special feature. Nevertheless, it was agreed that a museum is not the place to hold nature-study classes for children, although well adapted for classes of teachers. Prof. R. Meldola, in testifying to the value of nature-study, expressed the opinion that it should be regarded as a method of training, not as a subject for teaching, and that it should include the study of the inorganic world; he also emphasised the necessity for nature-taught teachers.

The dispersal of plants was a subject to which the late Prof. Errera devoted much attention, and among the problems which came under his notice was the manner in which plants manage to reach rocks isolated by glaciers. In this connection he visited the isolated peaks, Aguagliouls, by the side of the Roseg glacier, and Isla Persa, flanked by the Morteratsch glacier. A posthumous paper published in the *Recueil de l'Institut botanique Léo Errera* (vol. viii.) contains a list of the plants collected on these rocks and on the moraine adjoining the former. There is a remarkable contrast between the species growing on the peak Aguagliouls and the moraine; on the moraine three species of Trifolium and *Anthyllis vulneraria* were taken, and Primulas were wanting, while on the peak the Leguminosæ were represented by one Trifolium, but six species of Primula were collected.

The vigorous efforts made by the American agricultural colleges to get into touch with the practical man are well exemplified by the large numbers of bulletins they issue dealing with every phase of agriculture and every problem about which it is supposed the farmer requires help. We have received a series of bulletins from the Colorado Agricultural College which are quite typical of their kind; the subjects dealt with are the cultivation of fruit trees, pig production, and the manufacture of gate-posts out of cement. The bulletins are drawn up by experts, are clearly written, and well illustrated. The cost of production and distribution must be considerable.

The United States Department of Agriculture has recently issued a popular bulletin by Mr. Milner on the use of milk as food. It is stated that about one-sixth of the total food of the average American family is furnished by milk and its products. A simple account is given of its properties and of the effects of bacteria; a number of milk products are described, and comparison is instituted between these and other nutrients. It is further shown that milk is quite as economical as other animal foods, but dearer than most vegetable products; as a source of protein it is especially economical.

WE have received from the Michigan State Agricultural College Experiment Station a bulletin describing a local cattle disease known as the Grand Traverse or Lake Shore disease. At the outset the head is carried low with drooping ears, the coat stares, and the appetite falls off. The animals drink less and less as the disease advances, until finally they refuse to drink at all. As the appetite fails it becomes depraved, and such materials as bones, wood, leather, rope, or bark are eaten. The animals become extremely emaciated. The seat of the disease appears to be in the third stomach, where extensive lesions are often found. The cause of the disease is obscure, but some evidence was obtained that showed it lay in the methods of feeding. Experiments to test this view are in progress.

AMONG some miscellaneous publications to hand from the United States Department of Agriculture is one on the method of winter fumigation for the white fly infesting citrus trees. The tree is covered with a sufficiently large tent in which hydrocyanic acid is being generated; by careful attention to certain details the fly can, it is said, be exterminated at a small cost. A Farmers' Bulletin gives a short summary of the results obtained at some of the agricultural experiment stations. No fewer than ten different subjects are dealt with, and references are given to the original sources, from which farmers who wish to do so can readily obtain fuller information. Another bulletin describes the card-index sets now being made up and sold, in which are catalogued the publications of the Departments of Agriculture, the Geological Survey, and the State Surveys. Such an index is indispensable in the United States, where an enormous number of official publications are issued every year.

THE *Geographical Journal* for November contains a short report, by Sir Ernest Shackleton, on some results of the British Antarctic Expedition of 1907–9. The paper gives a summary of the routes of the chief expeditions from the headquarters at Cape Royds, and a brief narrative of the most important events which occurred during each. It is announced that most of the volumes containing the scientific records and results of the expedition will probably be issued within the next twelve or eighteen months. The contribution is accompanied by three maps.

DR. WARREN DU PRÉ SMITH, chief of the Division of Mines, Bureau of Science, Manila, contributes a paper to the November number of the *Geographical Journal* on geographical work in the Philippines. The work under the American *régime* is carried on primarily by the United States Coast and Geodetic Survey, which is responsible for the most accurate surveys, but mapping is also done by the United States Army, the Bureau of Constabulary, the Bureau of Lands (cadastral surveys), and the Division of Mines. The land area of the Philippines is approximately 115,000 square miles, and of this about 14,000 square miles had been covered by triangulation, and the topography of 1500 square miles mapped up to June 30, 1908.

THE *Revue des Idées* for October contains an article, by Prof. Jacques Loeb, of California, entitled "Les Tropismes et la Psychologie." The writer refuses to accept the common view that a physical interpretation, however complete, of a psychical phenomenon can never afford an explanation of its psychical character. He maintains that the "will" of an animal is merely a term useful to cloak our ignorance of the forces determining its movements, and that the scientific solution of the problem of volition consists solely in discovering those forces and the laws according to which they act. He adduces evidence in favour of attributing to positive or negative heliotropism the reactions of aphides, bees, ants, &c., to light. He combats the experimental work of Jennings and others who claim to have established the inadequacy of mechanical processes to account for the behaviour of even the lowest organisms.

MR. G. L. GOMME contributes to the *Sociological Review* for October an important paper treating of sociology as the basis of inquiry into primitive culture. He lays down as the fundamental proposition of anthropological research "that inquiry into the culture and condition of primitive man as he is represented by modern savages, in the remains of decayed civilisations, or in the ancient records of the beginnings of modern civilisations, can only be conducted by considering each item of culture which is the subject of inquiry in association with all the other items of culture in the same social group." The original social unit consists of the tribal rulers and the tribal village, representing the one a conquering, the other a conquered, race. Slavery in Indo-European society means, not personal servitude, but the status of a class springing from the conquered people. Indo-European tribalism is not only a polity, but a religion, and it was indestructible. The tribe is founded, not alone on blood kinship, but also on common worship. He perhaps goes too far in extending Robertson Smith's theory of sacramental kinship with the deity to non-Semitic communities; but, with this reservation, his study of early tribal origins is interesting and suggestive.

PEOPLE who are seriously interested in aërial navigation will regret that the weekly *Ila*, issued in connection with the Frankfurt Exhibition, terminated on October 16. The seventeen issues contain many important and well-written articles dealing with various aspects of aërotechnics. Among the subjects treated are aërial motors, by E. Rumpler; materials and machinery, by August Bauschlicher; measurements of air resistance at Lindenberg, by Dr. F. Bendemann; aërial electricity, by O. Voigt; wind statistics, by W. Peppler; bird flight, by F. W. Lanchester (translated by H. Hochschild); the special steel industry, by W. Eilender; meteorological statistics for airships, by W. Peppler; balloon photography, by Captain Scheimpflug (abstract); aërodynamical researches, by Prof. Ahlborn (some of whose photographs of stream lines closely resemble those recently obtained by W. E. Williams in this country); besides unsigned articles on vehicles for transport of hydrogen, lamps for hangars, the Parseval balloon, and technical notes. The seventeen numbers of *Ila* will preserve their place in the literature of aërotechnics long after the great majority of journals of mushroom growth have passed into oblivion.

SEVENTY out of the hundred and eighty pages of the August number of the Proceedings of the American Philosophical Society of Philadelphia are devoted to papers dealing with seismological subjects, some of which have been mentioned already (June 10, vol. lxxx., p. 444). The first, on the causes and effects of earthquakes, by Mr. E. O. Hovey, treats the subject in a popular manner, and contains descriptions of the Charleston (1886), the California (1906), the Kingston (1907), and the Messina (1908) earthquakes. The second, by Mr. W. H. Hobbs, deals with the evolution and outlook of seismic geology, and advocates two lines of advance:—first, to make practical use of the knowledge already gained, and second, to refine our instruments until we are capable of forecasting the time, place, and severity of the next earthquake. He points out the importance, as a means of forecasting, of the principle of immunity from shock for a long period of a region which has just experienced one, and suggests that more refined instruments may show that slight tremors precede all shocks. A third paper, by Mr. H. F. Reid, urges the United States Government to found a seismological bureau for the study of earthquakes, particularly in the United States.

Marine steam turbines show generally a lower efficiency as compared with corresponding land turbines on account of the compromise which has to be made regarding speeds of revolution. This is owing to the fact that the propeller has best efficiency at comparatively low speeds, while the turbine gives best results at high speeds. In *Engineering* for November 5 is described one of the several methods which have been tried for securing a reduction of speed from the turbine to the propeller, thus enabling both to be worked at their best speeds. The arrangement is due to Dr. Föttinger, of the Vulcan Company, of Stettin, and consists of a differential water-turbine transmitter in which the primary water-wheel is driven by the steam-turbine shaft, and transmits water with a certain velocity through guide blades or directly to a secondary wheel or wheels mounted on the secondary or propeller shaft in the same axial plane. Transmission ratios of from 3/1 up to 12/1 can be provided, and reversal can be obtained by means of a reversing water-turbine transmitter of somewhat similar design on the same shafts. With an experimental installation at the works in which the primary shaft runs at 1600 revolutions per minute and the propeller shaft at about 270 ahead, reversal to 250 revolutions astern can be obtained in nineteen seconds. The efficiency of power transmission rises rapidly to 78 per cent. at 600 revolutions per minute of the primary shaft, and remains constant at 83 per cent. at 1250 revolutions. This installation has a transmission ratio of 4·5 to 1. The Vulcan Company have built a special steamer for trials with this arrangement, and it will also be probably tried on warships. The arrangement seems to be valuable and likely to come into extensive use.

We have received from Mr. Bernard Quaritch, 11 Grafton Street, New Bond Street, London, a copy of his current issue of rare and valuable books now offered for sale. The list includes many interesting volumes concerned with America and Australasia.

Messrs. Longmans, Green and Co. will publish in a few days "Beasts and Men: being Carl Hagenbeck's Experiences for Half a Century among Wild Animals," an abridged translation by H. S. R. Elliot and A. G. Thacker, with an introduction by Dr. P. Chalmers Mitchell. Carl Hagenbeck is the founder of the famous Zoological Park at Stellingen, near Hamburg.

Reference has been made before in these columns to the convenience of the circulating library of Mr. H. K. Lewis, Gower Street, London, to students of science and others. The most recent list of new books and new editions added to the library during July, August, and September of the present year shows that great pains are being taken to keep the library complete and up to date.

The Cambridge University Press announces as in the press "Mathematical and Physical Papers," by the late Lord Kelvin, vol. iv., hydrodynamics, containing vortex motion, tides, and waves on water, collected and arranged by Sir J. Larmor, secretary of the Royal Society. The same publishers have in preparation "Lord Kelvin: Scientific Remains," including excerpts from early diaries and from his scientific correspondence, together with a reprint of the historical account of his scientific career prepared for the obituary notices of the Royal Society. This work is also by Sir J. Larmor.

OUR ASTRONOMICAL COLUMN.

A Brilliant Meteor.—A magnificent meteor was observed, at 11h. 59m., at the Solar Physics Observatory, South Kensington, on November 15. The observed path was from about $114\tfrac{1}{2}^\circ$, $+27\tfrac{1}{2}^\circ$ to $87\tfrac{1}{2}^\circ$, $+6^\circ$, *i.e.* from immediately below Pollux to immediately below Betelgeuse, the path being nearly horizontal.

The meteor was very bright, exhibited striking red and greenish tints, and travelled with a medium velocity. It did not explode, but the large bright head simply faded away, leaving a definite trail, which endured for some two or three seconds.

Elements of Halley's Comet.—The following five elements of Halley's comet are those calculated by Mr. P. H. Cowell, F.R.S., and Mr. A. C. D. Crommelin, from the perturbations since 1835:—

Longitude of ascending node	57 16 12
Node to perihelion	111 42 16
Inclination of orbit	162 12 42
Semi-major axis of ellipse	17·94527
Eccentricity...	0·967281

The above elements have not yet been re-determined from recent observations.

The predicted date of perihelion passage was 1910 April 16·6.

The observed positions in 1909 September and October can be satisfied, both in right ascension and declination, by altering the date of perihelion passage to 1910 April 19·7 and retaining the predicted values of the other elements.

Recent Observations of Mars.—In No. 4367 of the *Astronomische Nachrichten* M. Jonckheere gives 24·325″ as the mean diameter of Mars from several observations near opposition; at unit distance this would be 9·533″, which means that if the diameter of the earth be taken as 1·0, that of Mars is 0·540. The observed flattening of the polar diameter was 1 : 270·8. A list of nine probably new canals is given, names being proposed for six of them which are certainly novel.

In No. 4368 of the same journal M. Jonckheere gives two drawings, made on September 30, 11h. 30m. (long. 210°), and October 5, 10h. 10m. (long. 145°), respectively. On the former date a number of "lands" and thirty-four canals, four probably new, were seen, and on the latter date forty-nine canals, six probably new, and seven "lands" were recorded. Among the latter were the two new ones, Stella, near the polar cap, and Thaumas, in the Aonius Sinus.

No. 4367 also contains a note, by M. Jarry Desloges, recording the observation and disappearance of a terminator projection in the region of Daedalia, variations in the Lacus Solis, the Auroræ Sinus and Deucalionis Regio, and the discovery of two new canals.

A paper by M. Desloges also appears in No. 17 of the *Comptes rendus* (October 26), in which the author divides the canaliform markings into three types:—(1) broad greyish bands; (2) lines of medium breadth, very dark, and with definite edges; (3) fine lines near the limit of visibility. He suspects that some features of the first type have, at times, been resolved into finer details, whilst among those of the second type changes have undoubtedly taken place. The finer markings, type 3, appear to have become greatly augmented in number. His collaborators, MM. Fournier, saw Araxes, type 1, single, then double, and finally triple, but M. Desloges himself has never been certain of seeing a canal doubled. Two charts given in the paper show the Martian features in spring (southern hemisphere), and later at the beginning of summer, and it is seen that at the later epoch the markings were more numerous and better defined.

Perrine's Comet, 1909*b*.—From the recent observations (August–October) of Perrine's periodical comet Dr. Kobold has calculated a set of elements, which he gives in No. 4368 of the *Astronomische Nachrichten* (p. 405, November 10); this gives the perihelion passage as 1909 October 31·865 (M.T. Berlin). An ephemeris is also published showing that the comet is apparently travelling, nearly due south, through Gemini, as shown by the following positions:—November 18, 7h. 3·8m., +17° 46·8′; November 30, 7h. 11·9m., +5° 45·5′. On November 19 the comet will be some minutes west of λ Geminorum, and of about magnitude 12·3.

The Liverpool Astronomical Society.—The annual report of the Liverpool Astronomical Society shows that its activity and membership are being well maintained. In the presidential address Mr. W. E. Plummer gives an interesting paper on satellites, and other notes, by Mr. Thorp and Father Cortie respectively, deal with diffraction gratings and sun-spot spectra. There is also a paper on Morehouse's comet, illustrated by a frontispiece reproducing photographs taken by four of the society's members.

The Parallax of the Double Star Σ 2398.—In these columns on September 16 we directed attention to Dr. Bohlin's re-determination of the parallax of the double star Σ, from which it followed that this star, with a parallax of 0·484″, is the nearest to us in the northern hemisphere.

Since Dr. Bohlin's publication several observers have directed attention to the discordance of the above value from several previously determined, Prof. Schlesinger pointing out (*Astronomische Nachrichten*, No. 4365, p. 359) that it is probably 0·15″ too high.

Dr. Bohlin now states (*ibid.*) that an error crept into his calculations, and that, on correcting this, the parallax derived from his observations is +0·251″; there are, at least, eight or nine stars in the northern hemisphere for which greater parallaxes than this have been found.

THE MEASUREMENT OF SOLAR RADIATION.[1]

In the long memoir referred to below Dr. Bemporad discusses a variety of problems relating to the measurement of solar radiation, a subject to which he has made previous contributions. The material employed consists mainly of observations made with pyrheliometers of the now common Ångström pattern at the peak of Teneriffe during five days in June and July, 1896. Prof. Ångström and an assistant observed at two different heights, the two stations simultaneously occupied being one at a level of 3252 metres, the other at one or other of the three levels 3683, 2125, and 360 metres.

On an average day there were about sixteen observations at each of the two stations occupied. The observations were scattered over the day, the zenith distances of the sun usually ranging from a little more than 5° to between 80° and 90°. The pyrheliometer reading on reduction gives q, the heat received in unit time by a unit of surface placed orthogonally to the sun's rays. As the sun's zenith distance alters, there is at any station a change in the length of the path of the sun's rays through the atmosphere. The longer the path, the greater the loss by absorption, and the first problem considered by Bemporad is which of several formulæ, due to Crova, Bartoli, Pouillet, and himself, best represents the variation of q with zenith distance. The formulæ all contain a quantity e defined as the "mass" of air traversed by the rays (for this purpose a ray may be regarded as a tube of unit section), unity representing the value of e for a vertical ray. The author refers to a previous memoir, in which he has tabulated e as a function of z, the zenith distance, at sea-level. Treating the morning and afternoon observations of each day at each station separately, he calculates the best values for the constants q_0 and m in a formula of Crova's type $q=q_0(1+e)^{-m}$. The average difference between the individual observed and calculated values is usually well under 1 per cent. The author seems, however, to prefer a three-constant formula of the type $\log q=a-be^n$, and makes numerous comparisons with formulæ of this type.

If we neglect the earth's curvature and the small variation in z at different levels due to refraction, and regard the atmosphere as formed of "layers" bounded by parallel planes, an increase of z increases the length of path in all layers in the same proportion. Thus the formulæ involving e do not really assume that the absorption in travelling through a given "mass" of air is the same at all levels. With the view of ascertaining the variation in absorption with height, the author proceeds to calculate the "mass" of air traversed by rays, having different values of z, in passing from the level of one of Ångström's stations to another. This is got by a slight modification of the difference between the air "masses" from sea-level up to each of the two heights, as given in a table previously published by the author. One assumption in the process which rather invites criticism—though there is no obvious means of avoiding it in the absence of direct observations—is that the temperature gradient was the same at all levels and deducible from the observations at the two stations. Having found M, the "mass" of air traversed between the levels of the two stations, the author assumes that the simultaneous values q and q' of q at the two stations are connected by a formula of the type $\log(q'/q)=c\mathrm{M}$, where c is the mean absorption per unit mass of air for the layer between the two heights. Ångström's four stations supply, of course, three layers, though the data for the three refer really to different days. Thus three values of c—answering to three different layers or to three different mean heights in the atmosphere—are obtained for a series of different values of z. One noteworthy feature is the tendency of c, for a given value of z, to be greater in the afternoon than in the forenoon. The author finds c to diminish notably with the altitude of the layer, and he concludes in favour of the empirical law that the absorption at different heights varies as the fourth power of the density of the air. This conclusion was derived primarily from Ångström's observations alone, but the author tests it by reference to results obtained by Millochau at Mont Blanc, Langley at Mount Whitney, and Rizzo at Rocciamelone. On p. 97 he considers the relationship of his formula to the law of variation with height usually proposed for aqueous vapour.

In an earlier paper the author had tabulated the value M of the "mass" of air traversed by a ray between sea-level and heights varying up to 5000 metres for different values of z. His calculations assumed the temperature gradient β to be 6·2° C. per km. In an appendix to the present memoir he gives the corrections to be applied to the previous table when the value of β is not 6·2°, but 6°, 5° . . . 0°. By a curious oversight the table for $\beta=2°$ is printed twice over on p. 103, that for $\beta=1°$ being omitted.

The author refers in various places to the fact that the absorption by the atmosphere is selective, the presence of aqueous vapour in the lower strata being specially important; but Ångström's observations in 1896 dealt only with the total radiation. He also recognises that the presence of a mountain may disturb the atmospheric conditions in its immediate neighbourhood. He apparently ascribes to this—and with good reason—certain anomalous results derived from Ångström's two highest stations, according to which the absorption in the intervening layer was at times negative. One cannot but entertain some doubt whether the subject is yet quite ripe for mathematical calculations of so elaborate a type as the author's. There would certainly have been a much more suitable field for their application if he had had at his disposal absolutely synchronous data from seven or eight stations—preferably in the free atmosphere—at heights differing by regular intervals of, say, 500 metres, results being obtained, not merely for the total radiation, but for the portions passed by a series of filters after the method recently proposed by Ångström.

C. Chree.

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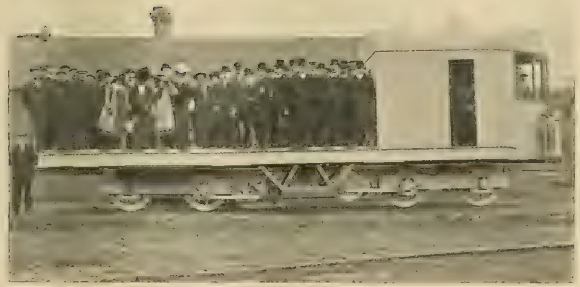
[1] "L'Assorbimento selettivo della Radiazione solare nell' Atmosfera terrestre e la sua variazione coll' altezza." By Dr. A. Bemporad. Pp. 111. From Reale Accademia dei Lincei, anno cccv., 1908. (Roma: Tipografia della R. Accademia dei Lincei, 1908.)

THE BRENNAN MONO-RAIL SYSTEM.

IT will be remembered that Mr. Louis Brennan exhibited a model mono-rail vehicle at the Royal Society soirée in May, 1907. Aided by grants from the War Office, the India Office, and the Cashmir Government, Mr. Brennan has developed the system, and we have now to record public trials of a full-sized vehicle which were made at the Brennan Torpedo Works, near Chatham, on Wednesday, November 10. A full account of the gyroscopic principles involved was given in NATURE of March 12, 1908.

The track consists of a single-rail circular portion of 105 feet radius, a straight portion 440 yards in length, and sidings. The rails are of the Vignoles section, $5\frac{3}{4}$ inches high, 70 lb. to the yard, and have the heads rounded to a radius of 5 inches. These are laid on sleepers 3 feet 6 inches long at about 3-foot centres on soft made ground, the rails being spiked to the sleepers. The points consist of two short lengths of rails fixed together and capable of sliding sideways so as to bring whichever is required into line with the fixed rails. The car is a platform 40 feet in length and 10 feet in width, having the machinery cab at one end, and is supported on two bogies, the centres of which are 20 feet apart. Each bogie has two double-flanged wheels 3 feet in diameter, of wheel base 5 feet 4 inches. To obtain flexibility in rounding curves, the bogies have their centre pins connected to the body by means of ball bearings. The empty car weighs 22 tons, and is designed to carry a load of from 10 to 15 tons.



Four-wheel self-propelling mono-rail car.

The power required is derived from two petrol-electric sets of 80 and 20 horse-power respectively, the petrol engines being direct-coupled to dynamos. It is, of course, possible to collect current from an overhead wire, or to use steam or other motive power. Current is supplied from the generating sets to two 40 to 50 horse-power motors on the bogies for propulsion, the motors being geared to an intermediate shaft, from which the wheels are driven by balanced cranks and coupling rods. Current is also supplied to the gyroscopic motors, to a compressor for operating the Westinghouse brake and the gyroscopic control gear, and to a small motor driving an oil pump.

Each of the two gyroscopic wheels is 3 feet 6 inches in diameter, and weighs three-quarters of a ton; the axes are normally horizontal, and perpendicular to the direction of the rail. Each is driven at 3000 revolutions per minute by a direct-current shunt motor, having the field magnets on the frame and the armature on the gyrostat shaft. The whole is cased in, and a vacuum is maintained of $\frac{1}{2}$-inch to $\frac{5}{8}$-inch of mercury for the purpose of minimising the air resistance. Although the vacuum will last several hours, a pump is kept running in order to keep it as low as possible. Mr. Brennan has noticed that, while the motors run cool under a good vacuum, they become hot directly air is admitted to the casing. The shafts have steel journals running in white-metal bearings under forced lubrication, the oil being cooled before being returned to the bearings.

During the trials on November 10 the smaller generating set alone was in operation, giving a speed of seven miles per hour. At this speed there was no difficulty in carrying forty persons round the circular track, on to the straight, and over reverse curves of 35 feet radius without material disturbance of the level of the car floor. Loaded on one side, the car-level first rises on that side and then gradually recovers; the steadiness is admirably shown by one of the photographs taken, showing thirty-six persons standing as close as possible to one edge of the platform with the car at rest. Mr. Brennan states that a load of two tons can be placed on the edge of the platform and then removed without danger of non-recovery of the level. The car at present can negotiate grades of 1 in 13, and, with an additional generating set, grades of 1 in $6\frac{1}{2}$ could be surmounted. Finality in design cannot be said to be reached as yet, and Mr. Brennan thinks that development will proceed in the direction of high-speed passenger trains having speeds up to 150 miles per hour.

THE RISE OF SCIENTIFIC STUDY IN SCOTLAND.[1]

AS the Royal Society is now about to open a fresh page in its history, it may not be regarded as an inopportune moment to sketch the rise of scientific study in Scotland, the means and opportunities afforded for that purpose, the formation of societies and institutions for the encouragement and diffusion of science in Edinburgh; also to put in the form of a continuous narrative the chief incidents in the growth of the society during the century and a quarter that has elapsed since its foundation.

Prior to the eighteenth century, and indeed during a considerable part of its course, Latin was the language in use for the interchange of thought and information amongst educated people at home and abroad. Treatises were composed in this language, lectures were delivered in the universities in Latin, and the theses presented for graduation were written and defended in the same tongue. Readiness to speak and understand Latin was a common bond of union amongst the learned, and distinguished them from the unlettered classes, whether of higher or lower social degree. Scotland participated in the revival of letters during the sixteenth century, and the names of George Buchanan, the representative Scottish humanist and historian of his time, of Andrew Melville, humanist and theologian, of James Crichton, surnamed the Admirable, were familiar to scholars throughout Europe. Contemporaneous with Andrew Melville was John Napier, the laird of Merchiston, the inventor of logarithms, a man of a different order of mind from the famous divine, one who by the publication of his great treatises, which were written in Latin, created a fresh era in the science of numbers, and provided mathematicians with a new and powerful instrument. To be conversant with Latin was a necessity for all who aspired to take rank in their respective professions. Those whose means enabled them to travel and to study in foreign universities could avail themselves of the instruction imparted therein, without requiring to have, as a preliminary, a good acquaintance with the language of the people. To cite an illustrious example from the south of the Tweed. William Harvey, the son of a Kentish yeoman, was educated in classics and physics at Gonville-Caius College, Cambridge. In 1598 he went to the University of Padua, where he studied under Fabricius, at that time the most eminent professor of anatomy in Italy. Profiting by the best means of instruction available at that time, and as a result of his own subsequent and independent observations and experiments, he discovered the circulation of the blood, and wrote his treatise "De motu Cordis et Sanguinis," which has made his name immortal, and has entitled him to be called the founder of exact physiological science, and the father of modern medicine.

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[1] Abridged from an address delivered before the Royal Society of Edinburgh on the occasion of the opening of the new home of the society, November 8, by Sir William Turner, K.C.B., F.R.S., president of the society.

Ambitious young Scotsmen did not lag behind in the desire to extend and perfect their studies by residence at schools of learning on the Continent. Literature, philosophy, and theology at first were the subjects of attraction; but later on medicine and science were cultivated with great zeal, and instruction and training in their application were obtained abroad of a quality surpassing that procurable in the universities of their native land.

In the latter half of the seventeenth century, three Edinburgh physicians, Sir Robert Sibbald, Sir Andrew Balfour, and Dr. Archibald Pitcairne, all of whom had studied abroad, took a leading part in the development and cultivation of medicine and science in Edinburgh.

Sibbald, Balfour, and Patrick Murray, the laird of Livingstone, being desirous of encouraging the study of botany, were bent on founding a medicine or physic garden, and, acting in conjunction with some other physicians, obtained a lease from the Town Council of the garden of Trinity Hospital for that purpose. They imported plants and seeds from abroad, obtained subscriptions from the nobility, the Exchequer, and members of the College of Justice, and established the garden which was the precursor of our world-famed Royal Botanic Garden.

In 1680 Drs. Balfour, Archibald Pitcairne, Sir Thomas Burnett, and other physicians met once a fortnight or so in Sibbald's house, to confer on "what was most remarkable a doing by the learned, some rare cases that had happened in our practice, and ane account of Bookes that tended to the improvement of medicine or natural history, or any other curious learning." So far as I have been able to ascertain, these conferences marked the first attempt in Scotland to bring together at regular intervals, for purposes of discussion and mutual improvement, those who had common interests in science and medicine. On St. Andrew's Day, 1681, after much negotiation, conducted principally by Drs. Sibbald, Balfour, and Stevenson, and with the aid of H.R.H. James, Duke of York, and Sir Charles Scarborough, His Majesty's first physician, a patent was granted by King Charles II. to found the Royal College of Physicians of Edinburgh, and in 1684 Sibbald was elected president of the college. After its institution the meetings for discussion and interchange of ideas were discontinued in Sibbald's hause, and were held monthly in the college.

In granting a charter in July, 1662, to the Royal Society of London, and one in 1681 to the Royal College of Physicians of Edinburgh, Charles did two wise actions, which have encouraged science, medicine, and learning, and therein have redounded to his honour and to that of his kingdom.

The scientific spirit and foresight shown by Balfour and Sibbald more than two centuries ago gave an impetus to the study of the natural sciences in Scotland, which as time went on resulted in the establishment of two institutions of which Edinburgh may well be proud, the Royal Botanic Garden and the Royal Scottish Museum.

Early in the eighteenth century, and during its continuance, a remarkable intellectual awakening took place in Scotland. Public affairs, with the exception of the abortive Jacobite risings in 1715 and 1745, had by this time become more settled. Through the development of agriculture, mining, manufactures, and commerce, Scotland had begun to emerge from being a poor country to a state of comparative affluence. Men found it possible to direct their thoughts to the arts of peace and to study letters, philosophy, and science. Within the universities, as well as in cultured society outside them, men of marked ability came prominently to the front, many of whom acquired, and have retained, a world-wide reputation.

An important change took place within the universities themselves in connection with the methods of instruction imparted in the faculty of arts. The old system of regents, under which it was the duty of each regent to act as tutor to a group of pupils from entrance to laureation, in all the subjects of a prescribed curriculum, began to be abolished, and a special subject was allotted to a particular teacher, who became a professor in that subject.[1] Encouragement was in this way given to a more profound study and fuller exposition of the subjects entrusted to the professors. Mathematics and philosophy, both natural and mental, especially commended themselves to the Scottish intellect. Great developments also took place in medicine and in the sciences on which it is based. The incorporation of the physicians of Edinburgh into a Royal College in 1681, the severance in 1722 of the corporate interests of the surgeons from those of the barbers, and the granting a new charter in 1778 to the surgeons, which incorporated them as a Royal College, greatly improved the tone and status of the medical profession in Edinburgh and in the adjoining counties.

As an indication of the value attached in Scotland during the eighteenth century to the medical education to be obtained in foreign universities, I may state that, from the foundation of the medical faculty in Edinburgh in 1726 until about the end of the century, fourteen of the professors in that faculty studied, either in whole or in part, in universities in Holland, France, or Italy, and many took the degree of Doctor of Medicine abroad. Of these, ten were educated at the University of Leyden, to which they had been attracted by the fame of Boerhaave.

The language common to all cultured people at that time enabled students to migrate from one European university to another, and to converse and receive instruction through one of the noblest of tongues, without having to resort to such mongrel forms of speech, to facilitate general intercourse amongst the nations, as have recently been devised by some ingenious persons. In the quality and range of their education and intellectual attainments, professors of science and the leaders in medicine were on an equal footing with the members of the Church and Bar, and with those who cultivated philosophy and literature. Members of the several professions acquired the habit of meeting together on a friendly footing, and were often joined by country gentlemen living in proximity to Edinburgh. Clubs and societies of various kinds, literary, social, medical, scientific, and legal, became the fashion.

In 1731 the leading physicians and surgeons in Edinburgh instituted a Medical Society for the improvement of medical knowledge. Monro *primus* acted as secretary, and under his supervision six volumes of "Medical Essays and Observations" communicated to the society were published. The "Essays" reached a fifth edition in 1771. They were translated into some foreign languages, were highly commended, and assisted in making the medical school of the University known throughout Europe. Shortly after the formation of the Medical Society several of the leading lawyers, professors in Edinburgh, Glasgow, and St. Andrews, country gentlemen, William Adams the architect, and others, formed a Society for Improving Arts and Science, particularly Natural Knowledge. Colin Maclaurin was the moving spirit; he and Andrew Plummer were secretaries, and the first president was James Douglas, fourteenth Earl of Morton, who became in 1764 president of the Royal Society of London.

(It may not be out of place to refer to the part taken by Scotsmen in the early history of the Royal Society of London. In the original charter appear the names of Sir

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[1] During the incumbency of the regents, Latin was the medium of intercourse between teachers and students. After the introduction of professorships the lectures in many subjects were delivered in Latin well into the eighteenth century. Sir Alexander Grant says that St. Clair, professor of medicine, lectured in Latin (1726–1747), as indeed was the practice with all the faculty of medicine, except anatomy. In Glasgow, Cullen lectured (1748) on botany in Latin, but his lectures on medicine were delivered in English. Sir Robert Christison relates in his "Autobiography" that in 1810 his oral examination for the degree of Doctor of Medicine was conducted in Latin. The theses presented for graduation in medicine in Edinburgh were written and printed in Latin down to 1833, and an occasional thesis in the same language was presented as late as 1844.

Robert Moray, Secretary to the Privy Council in Scotland, and William Aerskine (Erskine), a son of the Earl of Mar, one of the cupbearers to King Charles. They had been his companions in exile, and after the Restoration they were attached to his court and person. Moray had scientific tastes and pursuits, which led to his election as president of a society for the promotion of physico-mathematical experimental learning, which met in Gresham College, London, 1661–2. This society became, on the receipt of a Royal charter in July, 1662, the Royal Society of London, under the presidency of William, Viscount Brouncker. Moray had without doubt been the King's adviser in the granting of the charter. About a century later James Douglas, Earl of Morton, a mathematician and astronomer, a friend of Colin Maclaurin, and a former president of the Philosophical Society of Edinburgh, was in 1764 elected president of the Royal Society of London. Eight years later Sir John Pringle, of the family of Stichel, was made president. He had graduated as M.D. at Leyden in 1730, and settled in Edinburgh, where he held the chair of moral philosophy in the University from 1734 to 1742. He then joined the army as a surgeon, ultimately became Physician-General to His Majesty's forces, wrote a famous book on "Diseases of the Army," resided in London, and in 1772 was appointed president. After a long interval Lord Kelvin occupied the chair, 1890–5, and last year Sir Archibald Geikie was made president. Although not of Scottish birth or parentage, Scotland may claim to have participated in the training of Sir J. Dalton Hooker, president 1873–8, who was educated at the High School and University of Glasgow during his father's tenure of the regius chair of botany in the University; also of Lord Lister, president 1895–1900, who carried out his far-reaching researches when he held the chair of systematic surgery in the University of Glasgow, and subsequently that of clinical surgery in the University of Edinburgh.)

It does not appear that any of the communications made to the society in its early years were immediately published, as the troubles which arose in connection with the Jacobite rising in 1745, and the death of Maclaurin in the following year, suspended for a time its work. Proposals had been, however, made to the Medical Society to form along with it a conjoined society, which should carry its disquisitions into other parts of nature than those which immediately related to medicine, on the understanding that theology, morals, and politics were to be excluded. The larger society formed by this combination became the Philosophical Society of Edinburgh, and it published between 1754 and 1771 three volumes of "Essays and Observations, Physical and Literary," which had been read before the society, the last two of which appeared when David Hume and Monro *secundus* were secretaries. The "Essays" embraced a wide range of subjects, mathematical, physical, anatomical, botanical, medical, and surgical. Vol. i. is of interest in containing two papers by Alex. Monro, jun., afterwards *secundus*, then a student of medicine; and in vol. iii. a letter to David Hume is printed, dated 1762, in which Benjamin Franklin described his method of securing houses from the effects of lightning. To quote the words of Principal Forbes, the Philosophical Society of Edinburgh was the immediate parent of the Royal Society. As the Philosophical Society was a voluntary association, liable to be interrupted in its work, or even to be dissolved, it was considered advisable that an attempt should be made to form a society on a more permanent basis. A meeting of the professors of the University, many of whom were likewise members of the Philosophical Society, was called in 1782, when Principal Robertson proposed a scheme "for the establishment of a new society on a more extended plan, and after the model of some of the foreign academies, which have for their object the cultivation of every branch of science, erudition, and taste." As in the formation of the Royal Society of London, the patronage of the King had been solicited, and a charter of incorporation by the Crown obtained; a similar course in this instance was proposed and agreed to, and in March, 1783, King George III. granted a charter under the name of the Royal Society of Edinburgh.

The charter provided "ut Societas Literaria Edinburgi instituerctur, ad Statum illius partis Imperii nostri quæ Scotia vocatur accommodata," from which it is obvious that its scope was not limited to the city after which it was named, and in which it had its seat, any more than the corresponding Royal Society in the southern division of the kingdom was exclusively a society for London itself. The charter defined the range of study and research to be included in the work of the society, and specifically named along with the sciences of mathematics, physics, chemistry, and natural history, also archæology, philology, and literature.

The first meeting of the society was held on June 23, 1783, in the University library, with Principal Robertson in the chair, when it was resolved that all the members of the Philosophical Society should be assumed as members of the Royal Society, and that the judges of the Supreme Court and a number of other gentlemen should be invited to join it. The society in its first year had as president Henry, third Duke of Buccleuch, and numbered 102 resident and 71 non-resident members. It is interesting to note that the Senatus of the University of St. Andrews was represented by ten members, King's and Marischal's Colleges, Aberdeen, by sixteen, whilst fifteen members of the Senatus of the University of Glasgow were original fellows, so that its national character was emphasised from its foundation.

The fellows were divided into two classes, physical and literary, and a short time after the foundation of the society the physical class numbered 101, whilst the literary class contained 114 fellows. In the first four volumes of the Transactions of the Royal Society, from 1783 to 1797, the papers were grouped into two classes. In vol. i. twelve physical papers were published and eight literary; in vol. iv. thirteen physical papers and only two literary. It became obvious, therefore, at an early date that the physical or scientific work of the society would dominate the literary. In vol. v. (1805) it was not thought necessary to divide the published memoirs into these groups, and two papers on literary subjects and two biographies were printed without being classified apart from those relating to science. In the course of time communications on literary subjects became so few in number that they formed only a small part of the work of the society.

The society commenced to publish its Transactions in 1788, and up to the present date forty-six quarto volumes have appeared. Vols. i. to v. contained chapters entitled "History of the Society," which included its Proceedings from 1783 to 1805. The publication of the Proceedings was then suspended for nearly thirty years, but in December, 1832, the society began to issue the Proceedings independently, from which date to May, 1844, they were collected, and published in 1845 in an octavo volume, to be followed by twenty-five similar volumes up to 1907, when they were enlarged to a super-royal octavo.

The scheme for the encouragement of research, recently inaugurated by the Carnegie trustees, by the institution of fellowships and scholarships, has made a provision to aid in the maintenance of men of science of the younger generation during their years of probation. The conferring of grants of money to meet the expenses of research and publication has rendered valuable assistance to scientific and other investigators, and has enabled our society to provide more complete and finished illustrations to some of the memoirs than would otherwise have been possible.

Those of us who commenced scientific work fifty or more years ago cannot but recognise the enormous advance which has been effected in recent years in providing means and facilities for exact inquiry. Natural objects were present and visible to us and to our predecessors then as now. But the present methods of study are more exact, and opportunities for its pursuit are more easily obtained; instruments of research have become more powerful and more capable of assisting in penetrating deeper into the secrets of nature; novel phenomena have been disclosed to view and call for interpretation by men of science. The field of research is far from being barren and exhausted, for it is, and will continue to be, capable of producing ever-ripening fruit. It will be for the younger fellows and for those who may succeed them to bear their share in the extension of natural knowledge, to undertake the responsibility of continuing the work of the society, and to preserve the place which it has gained in the forefront of kindred institutions.

EXPERIMENTS AT HIGH TEMPERATURES AND PRESSURES.[1]

WITHIN a few miles of this lecture-room there is an unexplored region—to approach it we should have to move vertically downwards. It has been suggested by Mr. Parsons[2] that it would be worth while to make a short expedition in this direction, but the journey would be slow and the cost high—for instance, to bore a hole twelve miles deep was estimated to be a labour which would occupy eighty-five years and cost 5,000,000*l.* A well-to-do man desiring to benefit his fellow creatures could not do better than undertake this project, but until he comes forward we must perforce be content to try to imitate in our laboratories the temperature and pressure conditions which would be met with deep down in the earth.

Information, attainable from experiments under these conditions, is essential to the development of any exact concept of the structure and evolution of the earth. One of the most important questions in connection with the study of bodies under high pressures and at various temperatures is as to whether any particular body is solid or liquid under specified conditions, and, if solid, whether it is amorphous, glassy, or crystalline. That pressure would influence the melting point of solids was clearly put forward by Clapeyron in 1834, but it was not until after the establishment of the mechanical theory of heat in the "forties" of the last century that the exact numerical relations could be established, as was done by Prof. James Thomson in 1851, when he calculated, for the first time, the amount by which the temperature of fusion of ice would be reduced by a given increase of pressure. The ideas underlying such calculations are based on a consideration of the way in which heat is converted into mechanical work in any prime mover depending on a heat-supply, and were first formulated by Carnot in 1824, before the true nature of heat was understood. As the matter is fully dealt with in every text-book, I will merely remind you that Prof. James Thomson was able to obtain an equation between the mechanical work actually produced under stated conditions and the work which, according to Carnot's principle, must be developed by a reversible engine operating between fixed temperature limits upon a given amount of heat.

The general relation for a substance undergoing a change of state at absolute temperature T, such change involving a change of volume Δv and an absorption or emission of heat at constant pressure Q_p, is, reserving the question of sign,

$$\frac{dT}{dp} = \frac{\Delta v T}{Q_p}$$

or, in words, the change of melting point produced by unit change of pressure equals the product of the absolute temperature, and the ratio of the change of volume of unit mass on melting to the quantity of heat absorbed or emitted by unit mass in the process.

Now the greater number of substances when they pass from the liquid to the solid state evolve heat and contract in volume. An increase of volume is, of course, a positive quantity, and if heat is absorbed during this increase it is reckoned positive also. In the case of water, heat is evolved during freezing as in other cases, but the mixture of ice and water has a smaller volume than the solid ice. Accordingly, the change of volume in this case is negative, and the melting point falls as the pressure rises.

The first fairly exact confirmation of the theory appears to be due to De Visser;[3] who selected acetic acid most carefully purified as a test substance, though valuable experiments up to much higher pressures had been previously made by many others, particularly by Dewar on water,[4] Ferche on benzol,[5] and Damien[6] on a variety of substances.

It is necessary to work with a pure substance in order to test the theory, or at all events with one the solid phase of which has the same constitution as its liquid phase. If the acetic acid had not been pure, the probability is that the frozen part would have contained more or less of the impurity than the unfrozen, and consequently a state of affairs not contemplated in the theory would have arisen. From the experimental point of view, it is obvious that a sharp melting point is a necessary condition for its accurate observation.

A quantity of acetic acid—rather more than 40 c.c.—is confined by mercury in a closed apparatus based on a previous design by Bunsen, which also contains air in a graduated tube. When the acetic acid melts it expands, and compresses the air through the intermediary of the mercury, whereby the pressure can be inferred. The part of the apparatus containing the acetic acid is immersed in a bath which can be kept at any desired temperature. As the melting progresses a pressure is set up by the expansion, and finally attains such a value that no further melting can take place. We then have a mixture of solid and liquid acetic acid in presence of each other under a measured pressure and at a known temperature. The quantities entering into the calculation are ascertained from other experiments—notably the ratio of the change of volume to heat absorbed was ingeniously ascertained by a modification of Bunsen's ice calorimeter. The final result was that the rate of variation of temperature of melting point with increasing pressure was calculated to be 0·02421° C. per atmosphere as against 0·02435° C. found by experiment, a difference of 0·57 per cent. I have dwelt on this work at some length in the hope that it may make the nature of the problem clear. It is to be noted that the experimental difficulties are considerable, and are enhanced by the fact that we have no *a priori* reason to suppose that the rate of change of melting point with pressure is a constant quantity independent of the pressure. In fact, it was shown by Sir Joseph Thomson about 1886[1] that in calculating the change of melting point we ought to take into consideration "the difference between the energy due to strains produced by the pressure in unit mass before and after solidification." Sir Joseph Thomson's reasoning, based as it is on a generalised Lagrangian method of treating problems involving energy changes, is unsuited for discussion in a non-mathematical address, but it is easy to see that if the compressibilities of liquid and solid are different, then the change of volume accompanying the change of state of unit mass must itself depend on the pressure, and therefore the pressure change of melting point, which is proportional to the change of volume, must depend on the square of the actual pressure so far as this part of the effect is concerned. This anticipation was realised by Damien in 1891, who showed that the melting points of substances in terms of the pressure could be expressed by a formula of the kind

$$t = t_0 + a(p-1) - b(p-1)^2,$$

t_0 being m.p. under 1 atmosphere pressure.

I think we may add that there will also be a small effect depending on changes of energy in the capillary layer separating the phases.

The first adequate investigation of the change of m.p. under pressure over a wide range of pressures was made by Barus.[2] Time does not permit me to do more than exhibit the results obtained, though the apparatus employed was most cleverly designed. It requires great experimental knowledge and ingenuity to infer with accuracy changes of volume of a few per cent. of the original volume at pressures of 1500 atmospheres, nearly ten tons per square inch. If we note the pressures and temperatures of melting, and plot the result as a curve against the pressure and temperature, we obtain what is called a melting-point curve, and this divides the field into two parts, so that on one side of the curve the temperature and pressure at each point have such values that the substance is solid, while on the other side their values are such that the substance is liquid. It is instructive, therefore, to regard the melting-point curve as the line separating the region of solid from the region of liquid. Along the line, and along it only, *i.e.* at the pressures and temperatures indicated by points on the line, the solid and liquid phases can exist in equilibrium together. Such a diagram is called a "diagram of condition."

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[1] Discourse delivered at the Royal Institution on Friday, March 19, by Richard Threlfall, F.R.S.

[2] B.A. Reports, Cambridge, 1904, 672.

[3] Recueil des Travaux Chimiques des Pays Bas xiii., 1893, 101.

[4] Proc. R.S., xxx., 1880, 533.

[5] Wied. Ann., xliv., 1891, 265.

[6] C. R., cxii., 1891, 785.

[1] Applications of Dynamics to Physics and Chemistry, 259.

[2] Bulletin No. 96 of the U.S.A. Geological Survey, 1892.

By far the greater part of our information as to the quantitative relations of bodies at high pressures we owe to Prof. Gustave Tammann, who has collected his results in a book entitled "Kristallisieren und Schmelzen," the advent of which (1903) must be regarded as an important event in the history of the subject.

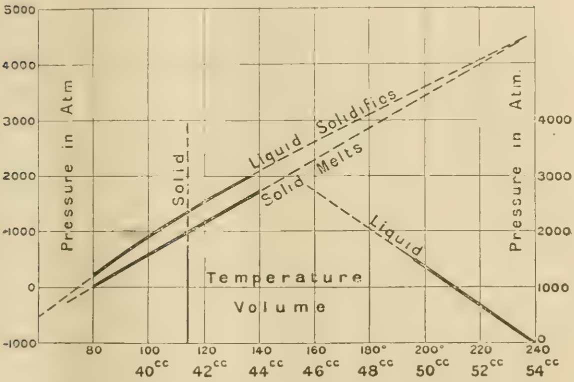

FIG. 1.—Full lines indicate part of field actually explored. Dotted lines indicate extrapolations.

The complete thermodynamic specification of a body involves a knowledge of its mass, volume, pressure, temperature, energy, entropy, surface tension, and nature, whether liquid, solid, glassy, crystalline, or amorphous.

Prof. Tammann has simultaneously measured the pressure, temperature, volume, and mass of many substances under high pressure, and at temperatures extending from 80° C. to 200° C.—taking cognisance of the physical state—and has thus been able to plot out many interesting diagrams of condition. The apparatus consists of a screw press by which a piston of ebonite is driven down a steel cylinder of small known cross-section. The cylinder is filled with oil, and the ebonite piston fits practically oil-tight. The oil communicates with the oil contained in a strong steel vessel, which also encloses a glass tube open at the lower end, containing the substance and dipping below the level of mercury contained in a dish. The oil occupies the rest of the space. The steel vessel is placed in a thermostat so that its temperature can be ascertained. The oil pressure is measured by a Bourdon gauge, which it was possible to standardise, thanks to the previous work of Amagat and Tait. In order to construct a diagram of condition, it is necessary and sufficient to find a number of points separating the liquid from the solid area, or separating the areas corresponding to different crystalline forms in the case where the transformation of one sort of crystal into another is under investigation. To understand how this is done, it is best to take a special case. If we have a quantity of a substance under a known pressure and temperature in the piezometer, and suddenly increase the pressure, so that there is not time for heat to pass in or out to any appreciable extent before the pressure gauge can be read, we have practically adiabatic compression. If the apparatus be then left to itself, the heat which we may suppose to be liberated by the pressure will slowly diffuse outwards, and the pressure will fall as time goes on. If we happen to start from a point on the m.p. curve before the pressure is raised, then the final result will be that we shall thaw or freeze more or less of the material, and the original pressure will be exactly regained, the change of state compensating the impressed change of volume. If, however, the increase of pressure has been so great that a change of state of the whole mass has been brought about, then the after variation of pressure will be so much greater that it is easy to distinguish this case from the previous one.

The accompanying diagram (Fig. 2), taken from Prof. Tammann's book, shows how the equilibrium curve can be located in the case of carbon dioxide and naphthalene. In the former case the temperature was 0·31° C. The pressure was 3800 kilograms per sq. cm., or 24·13 tons per sq. inch. (157·49 kilograms per sq. cm. = 1 ton per sq. inch = 152·38 atmospheres.)

The pressure was raised adiabatically to 4400 kg./cm.^{2} (27·93 tons/sq. inch), and the subsequent fall of pressure plotted against a time scale for ten minutes. The pressure was then adiabatically reduced to 3550 kg./cm.^{2}, and the recovery curve again plotted. The equilibrium pressure must lie between the pressures approached asymptotically on the diagram, *i.e.* between 3825 and 3792 kg./cm.^{2}. A repetition between narrower pressure limits enables the pressure to be fixed at between 3808 and 3797 kg./cm.^{2}. A similar procedure fixed the pressure of the m.p. of naphthalene between 3090 and 3080 kg./cm. at the temperature considered, a difference which corresponds to 0·2° C., the actual temperature possibly differing from the thermostat temperature by 0·1° C.

We may now pass on to the consideration of some of the results obtained, which refer, not only to change of melting points, but to changes in the temperatures of transformation of isomorphic forms.

As illustrations of such changes, I show here the transformation of yellow to red mercuric iodide, which shows well in the projection microscope; also Mitscherlich's transformation of potassium bichromate, and sulphur in two forms.[1]

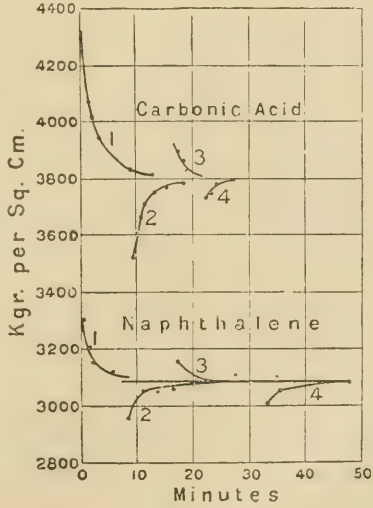

FIG. 2.

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[1] *Experimental Demonstration of a Transformation of Sulphur.*—A microscope slide is prepared by partially melting a fragment of monoclinic sulphur, and enclosing some of the melt between the slide and cover-slip, well pressed together. The presence of unmelted monoclinic sulphur insures the crystallisation of this variety on lowering the temperature. By means of a hot stage it is possible to preserve the crystallisation long enough to exhibit it by means of a projection polarising microscope. The appearance is very characteristic. Another slide is prepared, but this time all the sulphur is melted, and can generally be undercooled so far that it crystallises in what

The case of sulphur is one of great interest. It has long been known that sulphur can exist in at least three solid forms. It crystallises from some solvents in octahedral crystals, from others or from its liquid state in monoclinic crystals. In the latter case some amorphous sulphur is generally dissolved in the crystals, and the amorphous variety itself is formed in tough vitreous masses when molten sulphur, heated until it becomes very viscous, is poured into cold water. At ordinary temperatures the octahedral form alone is stable. It has been found that at atmospheric pressure octahedral sulphur is converted into monoclinic at 95·4° C., and in the process 2·7 gram-calories per gram of sulphur are evolved. The density of octahedral sulphur is about 2·03 and of monoclinic about 1·98 at ordinary temperatures. In accordance with the principles developed previously, the transformation temperature of rhombic to monoclinic sulphur must rise with increase of pressure. So far back as 1887 Roozeboom[1] was able to predict that the diagram of condition for sulphur would be as shown in Fig. 3.

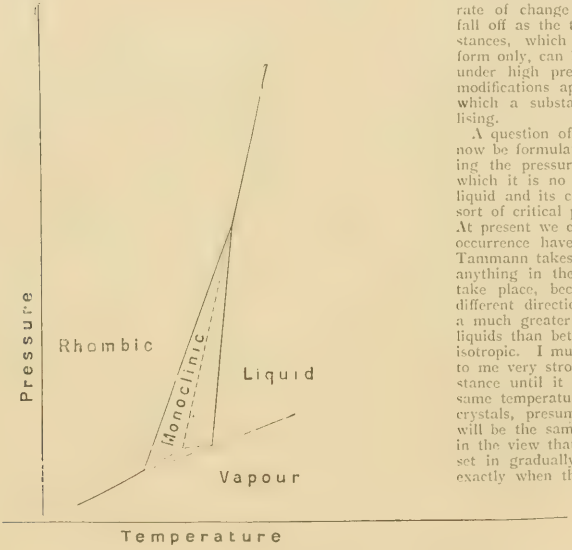

FIG. 3

Prof. Tammann has supplied the corroboration of the existence of the triple point.

Suppose that we have sulphur at a pressure of about 1500 kg./sq. cm. (9·52 tons/sq. inch) and raise its temperature to about 160° C. or more, we shall cut the melting-point curve of octahedral sulphur, and the sulphur will melt. If we then allow the sulphur to cool, keeping the pressure up, octahedral sulphur will crystallise from the melt instead of monoclinic sulphur. This very likely has some bearing on the occurrence of native crystals of octahedral sulphur.

It is not every substance which has such sharply defined properties as sulphur, though even these are not so sharp as they might be, owing to the constant presence of amorphous sulphur. An instructive case is afforded by phenol. As the diagram shows, there is a considerable region of the field in which two kinds of crystals of different density can exist together, the curves forming the boundary of this region of pseudo-equilibrium.

It may be that the two crystalline forms of carbon which apparently can exist together indefinitely at ordinary temperatures and pressures are an illustration of the same property.

As a final illustration we may note the results for water down to −80° C., from which it appears that it possesses three allotropic crystalline forms with at least two melting points.

The melting curves of from thirty to forty substances have been investigated, mainly by Tammann, up to about 3000 kg./sq. cm. = 19·05 tons/sq. inch, and the general result has been to show that there is a tendency for the rate of change of melting temperature with pressure to fall off as the temperature rises, and also that many substances, which at ordinary pressures crystallise in one form only, can be caused to assume allotropic modifications under high pressure. This tendency to form allotropic modifications appears to be associated with the extent to which a substance can be under-cooled without crystallising.

A question of the greatest interest and importance may now be formulated, What will happen if we go on increasing the pressure? Will a state of affairs be reached in which it is no longer possible to distinguish between the liquid and its crystalline form? Will there be, in fact, a sort of critical point at which the melting curve will end? At present we can only say that no indications of such an occurrence have been observed experimentally, and Prof. Tammann takes the point that it is highly improbable that anything in the nature of continuous transformation can take place, because a crystal has different properties in different directions related to its axes, and there is thus a much greater qualitative difference between crystals and liquids than between liquids and gases, both of which are isotropic. I must admit that this argument does not appeal to me very strongly. If it be possible to compress a substance until it reaches a state in which, at one and the same temperature, the liquid has the same density as the crystals, presumably the mean distance of the molecules will be the same in both cases. I see nothing monstrous in the view that in these circumstances crystallisation may set in gradually, and that it may not be possible to say exactly when the liquid ceases to be a fluid and becomes a crystalline solid. There are no theoretical or other grounds for supposing that the phenomena of crystal growth, as observed when there is a change of volume accompanying the crystal formation, will necessarily hold when no such change of volume occurs.

If we refer to the theory of the change of m.p. by pressure it is obvious that if either the change of volume or the latent heat of melting vanish at any temperature or pressure on the melting curve, then in the neighbourhood of this pressure the curve must degenerate to a point, or small pressure changes will not affect the m.p. It was pointed out, however, that there is a term or terms depending on the square of the pressure, and if these were relatively important the only thing we should notice would be a change of curvature at the point under consideration. It does not follow that there is no maximum or minimum to the melting temperature of any particular substance because the term in P^2 may be vanishingly small; it may be (and generally is) of opposite sign to the term in P, and in this case it is only a question of the relative importance of the terms where the maximum or minimum melting point lies. Damien's empirical formula expresses precisely the effect to which I refer. The practical result which is of importance in questions affecting the condition of the inner layers of the earth is that we are not entitled—in fact, it is wrong—to suppose that pressure must necessarily go on raising the melting point indefinitely; everything depends on the substance under con-

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is believed to be the octahedral system. This slide is then placed in the projection microscope, when it is seen that its appearance is totally different from that of the first slide. The preparation of octahedral sulphur is then heated on the hot stage, and when the transformation temperature is reached it is seen that the structure begins to change—the crystallisation breaks up and becomes granular, the granules showing in general much more colour than the original crystallisation. These granules are taken to be monoclinic sulphur. The temperature is now raised until about half the preparation has melted, and it is then allowed to cool back a little so as to crystallise. The crystals now show the characteristic monoclinic crystallisation with brilliant colours, since unmelted monoclinic sulphur is present.

[1] Rec. Trav. Chim. Pays-Bas, vi., 1887, 314.

sideration. It is therefore necessary to make such experiments as those of Tammann at vastly higher temperatures and pressures than those we have been considering, up to probably more than 10,000 kilograms per sq. cm. (or 63·5 tons per sq. inch).

In 1893 some experiments were described by Parsons[1] in which carbon rods were heated by electricity under a pressure usually of 15 tons per sq. inch, but rising in one case to 30 tons per sq. inch. The pressure was obtained by means of a hydraulic press, but no detail is given.

I have been desirous for many years of making some experiments at high temperatures and pressures, but for a long time could think of no way of ascertaining the pressure at temperatures over a red heat except by the use of compressed gases. In 1902 Sir Andrew Noble was kind enough to have some drawings prepared for a wire-wound steel pressure vessel to carry a pressure of 50 tons per sq. inch. The pressure was to be supplied by a compressed gas, and some details of the heating arrangements were designed, when a calculation of the cost of the gas compressors, vessel and appurtenances, made it clear that the undertaking would be beyond my means. I then endeavoured to find a simpler form of apparatus, and finally was led to contemplate the substitution of graphite for compressed gas, Spring having pointed out that crystalline graphite flows very easily at high pressures. A simple trial made it clear that the graphite of Ceylon does, in fact, possess the property of flowing like a liquid under high pressure to a sufficient degree to allow of pressure being transmitted by it. Graphite can be used, with some reservations, to transmit a pressure just like water or oil, though it is, of course, inferior in fluidity, and, as I have now discovered, occasions a loss of "head" which is not independent of the pressure itself. My former statement in the Chemical Society's Journal, 1908, is erroneous, though the results of the experiments are, I believe, hardly, or not at all, affected by the mistake, for a reason which will be clear later on. After several trials, the apparatus which I have here to-night was evolved, and some experiments were made with it. These experiments are not of any great importance, and, indeed, I feel almost ashamed of bringing them to your notice—I can only say, in excuse, that everything must have a beginning.

I believe, however, that the apparatus is sufficiently simple, cheap, and effective to enable others with more leisure at their disposal to make a beginning of an investigation of the properties of matter up to 100 tons per sq. inch, and at temperatures up to about 2000° C. At present, however, it is not possible to infer with accuracy the volume of the substance under these extreme conditions, nor can its physical condition be more than approximately and indirectly inferred—we must content ourselves with the production of transformations which we can make persist down to ordinary temperatures and pressures.

If we refer again to the sulphur diagram, we shall see how this possibility may arise. If sulphur is melted and cooled slowly, monoclinic crystals are found—when the temperature sinks below 98° C. these crystals undergo spontaneous transformation to the rhombic form—but all that we see is that the monoclinic crystals become opaque; the external form of the crystals is still monoclinic, but they are merely pseudomorphs of the original crystals.

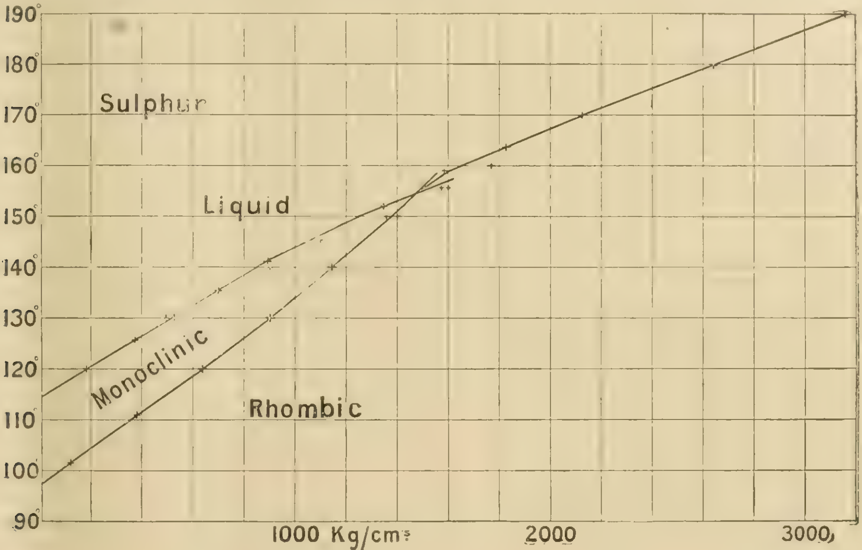

FIG. 4.

To obtain large octahedral crystals we may suppose that we begin by melting sulphur and raising the temperature and pressure until the former stands at 160° C. or over, and the latter at not less than 1600 kg./cm.^{2} (10·16 tons/sq. inch).

If we then slightly reduce the temperature or raise the pressure, we shall have the crystallisation of the sulphur in the rhombic form. By maintaining the pressure as the mass cools, and when it is cold releasing the pressure, we should finally extract rhombic crystals. To this we may, of course, add that we need not expect crystals of any size unless we cool at the proper rate. It appears that there are at least two phenomena requiring attention in relation to the production of crystals—one is the relation between the amount of undercooling necessary to induce spontaneous crystallisation, and the other is the rate at which the crystals will grow when they have once started. If we want large crystals we must not have an excessive number of points of spontaneous crystallisation, nor must we have too high a rate of crystal growth, or the crystals will by all experience tend to be felted together. 'The temperature condition giving birth to the most favourable number of spontaneous centres is not necessarily the temperature at which crystals grow to the largest size, so there is really no escape from finding by direct trial the most effective way to go to work.

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[1] Phil. Mag., xxxvi., 504.

Another possibility is brought to light by an examination of a case of pseudo-equilibrium, such as that of phenol. Here we have three regions—in one No. 1 alone is stable, in another No. 2, and in the third both Nos. 1 and 2 are stable. The case of iodide of silver is similar but more complicated. If in the area C we change the pressure, the temperature remaining constant and the material consisting of a mixture of the two stable phases, we can alter the proportions in which these phases exist, but we cannot cause either of them to disappear.'

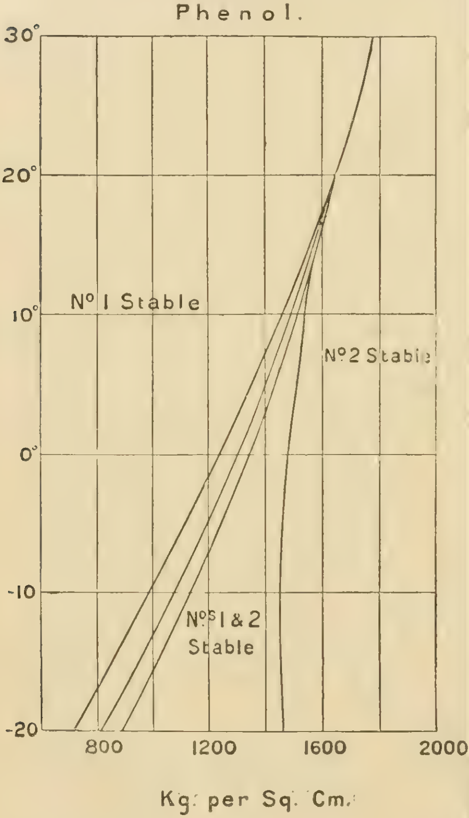

FIG. 5.

A notable case of this kind is that of graphite and diamond,' both perfectly stable in presence of each other at atmospheric pressure up to a temperature nearly that of the electric arc, say about 3000° C. If there be any similarity between the carbon and phenol diagrams, diamond would correspond to variety No. 2 of phenol and graphite to variety No. 1, heat being evolved in both cases when the less dense modification changes into the denser. If we desire to obtain phenol 2 from phenol 1, we note that, down to a temperature of −20° C., we should require to keep the pressure always above about 600 kg./cm.^{2}, otherwise the operations would be similar to those described in the case of rhombic sulphur.

Similarly, to convert graphite to diamond on this analogy we should have to raise the temperature and pressure together to some unknown values, and then let the product cool, keeping up the pressure meanwhile.

The apparatus which I have used in making the experiment is based on the transmission of pressure by crystalline graphite or the softer metals. In order to ascertain how much pressure is lost during transmission, I have arranged an apparatus in which the material to be tested is exposed to a known pressure, tending to force it through a cylindrical space, identical in figure with the space in which the heating is intended to be carried out. The pressure transmitted is transferred by a simple device to a piston with a hard steel point, and this is forced by the pressure to penetrate a soft steel plate. In a subsequent experiment the same piston is forced by a known pressure into the same steel plate so as to penetrate to the same depth as in the main experiment. It is then possible to compare the pressure transmitted with the pressure applied.

Experiments of this kind have been made with lead and with graphite as pressure-transmitting substances.

So far as I know, there is no substance other than graphite combining the property of a certain amount of fluidity with the capacity to resist high temperatures, and our hope of studying chemistry at really high pressures and temperatures appears at present to depend largely upon it. It is true that some attempts have been made to use compressed gases, but the apparatus is vastly more complicated, and the experiments themselves become really dangerous in view of the immense potential energy possessed by gases at pressures of 100 tons per square inch. As illustrating this, I may mention that 100 tons per square inch is about the highest instantaneous pressure noted by Sir Andrew Noble in his well-known experiments on the exploding of cordite in closed vessels. The density of nitrogen at 100 tons per square inch is, taking Boyle's law as a very rough approximation, 15,240 times its density under standard conditions. This works out to rather more than 19, *i.e.* about the same as gold, and the energy stored is of the same order as that contained in an equal volume of cordite, though its availability is lower.

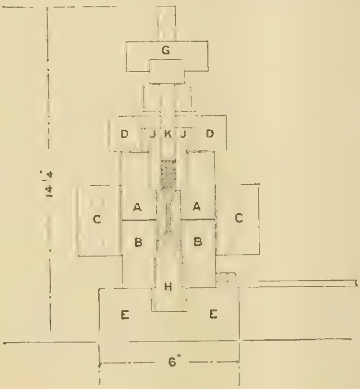

FIG. 6.

The construction of the apparatus I have used can be easily followed from the drawings. It consists essentially of a steel cylinder divided perpendicular to the longitudinal axis by a thin plate of mica, the two halves being clamped tightly together by an insulated ring and clamps at top and bottom. Pressure can be applied by an ordinary hydraulic lifting jack—the one I have used will lift fifty or sixty tons—the bore of the hydraulic cylinder being about 4½ inches. In order to operate at a high temperature it is necessary to line the cylinder with some refractory substance, and I have generally used magnesia for this purpose, though zirconia or thoria might be better. Purified magnesia is first melted in an electric furnace, and then ground in an iron mortar until it is very fine. The powder is freed from iron as well as possible by a strong magnet, and after being sifted is pressed into the cylinder little by little by hydraulic pressure so as to form a solid plug. This is then bored out with a hard steel drill to the required diameter. In pressing magnesia I have found that it is not possible to thoroughly consolidate the powder in greater thickness than a few millimetres, even under a pressure of 50 tons per square inch. In fact, magnesia is a substance which appears to be almost devoid of the fluid properties so marked in graphite—an essential condition for its use in the apparatus. I have tried various other linings, ground flint, alumina, &c., but they have no advantage over magnesia, and are even more difficult to drill out. Alumina prepared from the crystalline hydroxide is very easily compressed into cakes, and makes a good lining, but it is too fusible for experiments on carbon, and is probably more easily reduced. The cylinder having been lined, the bottom is filled in with Acheson graphite in electrical communication with the base of the apparatus. The substance to be operated upon is placed in the narrow part of the bore, and packed in with graphite or lead if that is suitable. The pressure is applied by a ram of hardened high-speed steel working upon a reservoir of graphite or lead contained in the plug closing the cylinder at the top and electrically connected to the other terminal of the supply. The chief uncertainty in regard to the pressure which actually reaches the subject of the experiment lies in the possibility of the ram being held to some extent by friction against the sides of the cylindrical hole in which it works, and in the consolidation of the graphite, with reduced fluidity, before it actually flows. One has to trust either to the hardness of the ram or to leave a space round it sufficient to allow graphite to escape, when the apparatus follows the lines of Amagat's standard pressure gauge, but the duration of the experiment is curtailed by the exhaustion of the graphite supply. A correction has to be applied for the pressure absorbed by the lead or graphite in accordance with the results of the preliminary trial. It is fair to say that no tendency of the ram to stick has ever been noticed—on the contrary, changes of volume brought about by heating have made themselves evident at once on the pressure gauge of the hydraulic press.

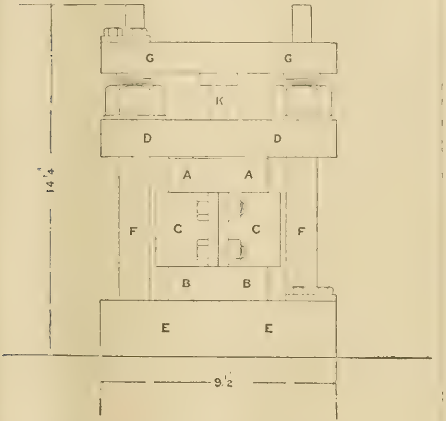

FIG. 7.

When working with any form of carbon there has been no trouble in arranging to heat the body which is being compressed by electrical means. It has been found most convenient to adjust the current to about the value required by means of a resistance—large compared with that of the pressure vessel—the latter being short-circuited meanwhile. In making an experiment, the hydraulic press is worked until the desired pressure is attained, and then by opening the switch the current is thrown on to the apparatus. When the magnesia lining begins to melt, the pressure, as shown by the pump gauge, is seen to fall, graphite flows into the magnesia tube, and the pump is worked so as to compensate for this. Under these conditions the pressure is probably transmitted without appreciable loss, as the narrow part of the cylinder is now in a fluid bath. After a sufficient time has been allowed the switch is closed, and the pressure kept up by pumping until the apparatus is cold. Originally an apparatus with a cylinder made in one piece was employed, and in this case there was a considerable voltage between the graphite entering the apparatus and the steel walls of the pressure vessel. After a few seconds of intense heating it frequently happened that an explosion took place, due (as could be seen by subsequent examination) to filaments of graphite being driven through the magnesia and producing short circuits against the steel vessel. With the construction above described these explosions do not occur, and there is the additional and very real advantage that when an experiment is over the apparatus can be opened in the middle and everything exposed to view.

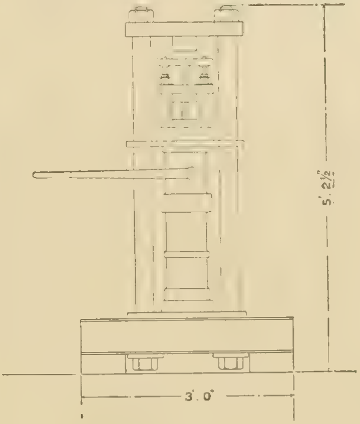

FIG. 8.

A large number of experiments were made on different kinds of carbon and graphite. The weight of material in the highly heated part was generally from 1 to 2 grams, and the energy supply was at a rate of 5 to 10 kilowatts for from three to six seconds. The pressure in a successful experiment lay at from 50 to 100 tons per square inch throughout. The magnesia lining was usually melted for a distance up to 1 centimetre round the graphite. Now magnesia melts at ordinary pressures at about 2000° C., but the energy supply is sufficient to render it possible that temperatures of from 3000° to 4000° C. may have been reached; it is possible that about 3000° C. was actually attained at the centre of the charge. The results obtained were uniform. No matter what form of carbon (excluding diamond, which was not tried) was packed originally in the apparatus, the final product was soft, well-crystallised graphite, which agrees with some results of similar experiments described by Mr. Parsons,[1] but not with the results claimed by Dr. Ludwig.[2]

In several experiments the crystalline mass of graphite was tested in regard to its porosity, and this was found to be considerable—a remarkable result, having in view the conditions under which it had been formed.

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[1] Proc. R.S., 79.

[2] Zeits. f [illegible] 1902, 273

Another point of interest was that where the soft graphite had been driven into the Acheson graphite plug at the bottom of the apparatus it became extremely hard, so much so that a hard steel file made little or no impression upon it.

The main difference in treatment of this part of the graphite as compared with the remainder is that it was cooled much more quickly, thanks to the high heat conductivity of the Acheson graphite plug. The cause of hardening has hitherto not met with any satisfactory explanation.

No appreciable quantity of carbide of magnesia was formed in the experiments. The magnesia close to the graphite core contained traces of carbides, but as there were always traces of iron left from the drilling-out process, this may be plausibly accounted for by the formation of carbide of iron.

The graphite was finally systematically searched for microscopic diamonds by Staudenmaier's modification of Brodie's method of conversion of graphite into graphitic acid,[1] or else by Moissan's modification of the same method.[2] A convenient means of distinguishing diamond in fine powder from most or all of the substances which are not separated by a liquid of density 3·34 at 4° C. is to heat the powder in a silver spoon to a dull red heat in fused potassium hydroxide. Check experiments showed that diamond dust easily passing a sieve with 100 threads to the inch would withstand the action of molten caustic potash at a temperature at which the edges of the silver spoon began to melt for five or ten minutes. Crystals of alumina or of carborundum are entirely destroyed by this fusion, but the diamond particles seemed to have undergone no change. In fact, the individual fragments could be recognised under the microscope after passing through the ordeal.

I am led to consider that my experiments indicate that no wholesale transformation of amorphous carbon or graphite into diamond can be brought about by temperatures of the order of 2000° C. and pressures of more than 50 and less than 100 tons per square inch. There is some uncertainty, as already mentioned, in regard to the actual pressures operative during the trials. Prof. Tammann has, however, obligingly directed my attention to the fact that the equilibrium curve graphite-diamond may nevertheless have been crossed, but that no diamond was formed because time for crystallisation was not allowed under the conditions of the experiment. I confess my idea in making the trials was that the amorphous carbon or graphite might be forced to melt, and then that the conditions would require it to re-crystallise as diamond—not, of course, in the form of large clear crystals, but rather in the form of bort or black diamond.

The experiments described have only been rendered possible by the invention of high-speed steel, which keeps its hardness up to nearly, or quite, a red heat, and any further advance—mainly in the direction of the allowance of more time—must wait for improvements in that material. It may very well be, however, that the limits of temperature within which crystallisation in diamond form can take place are really very narrow at any pressure; and in this case it will be a matter of very great difficulty to make an apparatus in which the conditions could be kept constant for a sufficient length of time, and the difficulty would be greater the higher the temperature.

It is noteworthy from this point of view that in Moissan's artificial production of diamond very much lower pressures and temperatures were used than those just described. I have shown[3] that, using iron as a solvent, it is highly improbable that Moissan attained a pressure of more than 20 tons/sq. inch, and when silver was employed the pressure must have been much lower. A similar criticism places the effective temperature of formation of diamond in iron or silver spheroids at something of the order of 1500° C. Comparing the experiments of Moissan with those described above, it looks as if Roozeboom's opinion is at present the most probable, viz. that solvents are necessary in order to depress the crystallisation point of diamond to a temperature at which the transformation to graphite is slow enough for rapid cooling to interrupt it. In this case the next step would be to repeat the experiments I have described at the highest possible pressure in the presence of iron, though Mr. Parsons[1] has already made some trials in this direction with negative results. We have, however, many metals which have never been tried in this connection, and one or other of them may turn out to have the requisite properties.

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[1] Ber., 1898, xxxi., 1485. [2] Electric Furnace, 49, translation.

[3] Journ. Chem. Soc., xciii., 1908, 1351.

[1] *Loc. cit*

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The board of anthropological studies has elected Mr. A. R. Brown, fellow of Trinity College, to the Anthony Wilkin studentship in ethnology and archæology. The John Winbolt prize has been awarded to Mr. E. T. Busk, of King's College.

A university lectureship in zoology, recently held by Prof. Gardiner, is now vacant. The general board of studies will shortly proceed to appoint a lecturer to hold office from January 1, 1910, until September 30, 1914. The annual stipend is 50*l*. Candidates are requested to send their applications, with testimonials if they think fit, to the Vice-Chancellor on or before Saturday, November 27.

The Vice-Chancellor gives notice, on behalf of the board of geographical studies, that the Rev. T. G. Bonney, F.R.S., has consented to deliver a lecture in Cambridge on Thursday, November 25, at 5 p.m., on "A Desert Phase in the Development of Britain." By permission of Prof. Hughes the lecture, which will be illustrated by lantern-slides, will be given in the large lecture-room of the Sedgwick Museum of Geology.

The professor of botany also gives notice that Dr. H. H. W. Pearson, of Gonville and Caius College (professor of botany in the South African College, Cape Town), has consented to deliver a lecture at the Botany School on Friday, November 19, at 5 p.m., on "A Botanical Journey in South-west Africa."

The general board of studies has approved Dr. C. S. Myers, of Gonville and Caius College, and A. E. Western, of Trinity College, for the degree of Doctor in Science.

LIVERPOOL.—Mr. W. S. Abell, instructor in naval architecture at the Royal Naval College, Greenwich, has been appointed to the chair of naval architecture endowed by Mr. Alexander Elder.

OXFORD.—Mr. Balfour will deliver the Romanes lecture in the Sheldonian Theatre on Wednesday, November 24. Lord Curzon of Kedleston, Chancellor of the University, will preside.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 11.—Sir Archibald Geikie, K.C.B., president, in the chair.—H. C. **Ross**: The vacuolation of the blood-platelets: an experimental proof of their cellular nature.—H. G. **Plimmer** and Captain W. B. **Fry**: Further results of the experimental treatment of trypanosomiasis, being a progress report to a committee of the Royal Society.—G. S. **West** and B. M. **Griffiths**: *Hillhousia mirabilis*, a giant sulphur bacterium.—Dr. H. B. **Fantham** and Miss Annie **Porter**: The modes of division of *Spirochaeta recurrentis* and *S. duttoni* as observed in the living organisms. The observations recorded were made on living Spirochætes. The examination of living material is imperative, as results based only on stained preparations are not always trustworthy. Both longitudinal and transverse division occur in Spirochætes, as seen in *S. recurrentis, S. duttoni, S. anodontae*, and *S. balbianii*. There is a periodicity in the direction of division exhibited by *S. recurrentis* and *S. duttoni*. At the onset of infection longitudinal division occurs. This is followed by transverse division of the

Spirochætes when the infection is at its height. As the infection draws to an end, and there is a diminution in numbers of the parasites, there is a reappearance of longitudinal division. Naturally there are times when both forms of division occur together. The observations relating to periodicity were made on peripheral blood of the host. The actual processes of division, and the movements of the parasites meanwhile, are set forth in detail in the paper.—G. A. **Buckmaster** and J. A. **Gardner**: The supposed presence of carbon monoxide in normal blood, and in the blood of animals anæsthetised with chloroform. In a paper published in 1898, Desgrez and Nicloux stated that the normal blood of Paris dogs contains about 1·6 c.c. of carbon monoxide per litre, and that when the animals are anæsthetised by chloroform the amount increases to 2·5 to 6 c.c., according to the duration of anæsthesia. Their method of estimating carbon monoxide consisted in passing the blood gases over iodine pentoxide at 150° C., and determining the iodine liberated by the method of Rabourdin. The authors have carefully re-investigated the question, making use of Haldane's method of estimating carbon monoxide by means of diluted blood, after having previously ascertained that far smaller quantities of this gas than those found by the French observers in normal blood gases could be readily detected. They find that *neither normal cats' blood nor the blood of cats anaesthetised by chloroform contains any detectable trace of carbon monoxide.* They also find that most of the chloroform in the blood comes off with the gases when extracted at 40° C. In order to arrive at an explanation of Nicloux's results, the authors (1) repeated his experiments with variations, investigated (2) the effect of heat on iodine pentoxide, (3) the effect of chloroform vapour on iodine pentoxide, and (4) the effect of chloroform vapour on alkalis. The latter experiments show that chloroform vapour is readily decomposed by passing over solid potash, and also by the reagents used in gas analysis, with the production of carbon monoxide. It is concluded from the experiments (1) that chloroform is not decomposed in the blood with formation of carbon monoxide; (2) the iodine liberated in the experiments of Nicloux was due, to some extent, to the direct decomposition of the iodine pentoxide by the chloroform vapour in his blood gases, but mainly to the carbon monoxide produced by *the action of this chloroform on the solid potash over which he passed the blood gases* in order to free them from carbon dioxide.—G. W. **Ellis** and J. A. **Gardner**: The origin and destiny of cholesterol in the animal organisms. Part vi., the excretion of cholesterol by the cat. In this paper the results of a number of estimations of the cholesterol content of the fæces of cats fed on a variety of diets—animal and vegetable—of known cholesterol content, are described. It was found that cats behave similarly to dogs when fed on meat diets, but the tendency for the change of cholesterol into coprosterol appears to be greater in the case of cats. The change is, however, never complete unless the diet contains a considerable amount of fat. In all these experiments the total cholesterol and coprosterol excreted was considerably less than that taken in with the food. Without considering the cholesterol poured into the gut with the bile, the percentage deficit was 50–60, an average loss of about 0·08 gram per day. In the case of vegetable diets free from cholesterol or phytosterol, the weights of food necessary to keep the animals in condition were larger, and the amounts of fæces very much larger, than in the case of meat diets. Small amounts of cholesterol were excreted, averaging about 0·03 gram per day, but no change into coprosterol took place. In the case of artificial diets to which measured quantities of cholesterol or phytosterol were added, no excess of cholesterol above that administered was recovered from the fæces. The bearing of these results on hypotheses advanced in former papers of the series is discussed.—Prof. W. A. **Osborne**: The elasticity of rubber balloons and hollow viscera (with a note by W. Sutherland).

Manchester.

Literary and Philosophical Society, October 19.—Mr. Francis Jones, president, in the chair.—L. E. **Adams**: Some notes on the breeding habits of the common mole. An account was given of observations on the length of time the young of the mole spend in the nest, and their rate of growth. Special breeding nests, sometimes as large as, but generally simpler than, the winter fortresses, from which they are further distinguished by the absence of a "bolt-run," are made by the female for the accommodation of the young. These are usually born about the middle of May, though they have been observed as early as April 24, the latest date on which they were found in the nest being June 25. The author thinks that, considering their subterranean existence, climatic changes have little influence on their pairing early or late. Fresh observations confirm the statement made in a former paper that only one litter is produced annually by each pair. In any given season all the litters were born within a period of three weeks, and, as the young remain four weeks in the nest, there could not have been time to rear two litters. In order to ascertain the rate of growth of the young, the author took one, for measurement and reference, from each of several litters, and, after replacing the nest as carefully as possible, repeated the operation at intervals of a few days. The tabulated results showed that head and body measured at birth 40 mm., and at the end of the third week 117 or 118 mm., at which limit they evidently remained for some weeks before growth recommenced. The young begin to leave the nest at the end of the fourth week, and the process is a gradual one, requiring for its accomplishment six or seven days.

Paris.

Academy of Sciences, November 8.—M. Bouchard in the chair.—G. **Bigourdan**: A means of removing astronomical clocks from the influence of the variations of atmospheric pressure. The apparatus described and figured maintains the pressure round the clock constant, this pressure being fixed so that it is always higher than any possible atmospheric pressure.—L. **Maquenne** and M. **Demoussy**: The influence of the ultra-violet rays on the growth of green plants. The ultra-violet rays were produced by means of a Heraeus quartz mercury lamp. It was found that the ultra-violet rays determine the death of plant cells in a relatively short space of time, comparable with that required for the sterilisation of a contaminated liquid. The action is especially on the surface. —A. **Calmette** and L. **Massol**: The precipitation of the tuberculins by the serum of animals immunised against tuberculosis. In a preceding note a description has been given of a method of immunising cattle against tuberculosis by the injection of bovine bacilli cultivated on glycerinated ox bile. This method furnishes a serum of extraordinary agglutinating power. In the present note the precipitation of tuberculin from physiological saline solutions by this serum is described, and the properties of the precipitated tuberculin discussed.—M. **Giacobini**: Observations of Halley's comet, made at the Paris Observatory with the 38-cm. equatorial. Details of the observations on November 5, 6, and 7 are given. The comet is at the extreme limit of visibility; a small nucleus of the fourteenth magnitude can be distinguished, surrounded by a nebulosity of about 5″ to 6″.—Arthur R. **Hinks**: The mass of the moon deduced from photographic observations of the planet Eros, made in the years 1900 and 1901.—Eugène **Fabry**: The modulus of a Taylor's series.—E. **Vessiot**: The groups of rationality of systems of ordinary differential equations.—Demetrius **Gravé**: An identity in the theory of binary quadratic forms.—H. **Pellat**: A compound pendulum of very simple construction giving immediately the length of the synchronous pendulum. A new method of determining *g*. A description of a bifilar pendulum the bob of which contains a cavity. Two determinations of the time of oscillation are made, in one of which the mass is altered by the addition of mercury to the cavity. A simple calculation gives the length of the equivalent simple pendulum.—L. **Bloch**: The phosphorescence and oxidation of arsenic. The phosphorescence of arsenic is always accompanied by the production of the oxide. No ozone is produced, and there are no phenomena of ionisation. Both the oxides of arsenic are produced, and this is the case during both phosphorescence and during combustion with flame.—C. **Féry** and C. **Chéneveau**: The total and monochromatic radiation of incandescent lamps. A study of the relation between temperature of the filament and watts consumed by the carbon and tungsten incandescent lamps.—Georges **Claude**: The frigorific recuperation of volatile liquids lost in various industries. In many industries, especially in the manufacture of artificial silk, smokeless powder and celluloid, considerable quantities of alcohol and ether are lost owing to the enormous dilution with air. A practical system is described in which the air containing these volatile vapours is compressed and gradually cooled by expansion to a temperature of −100° C., a special device being necessary for the preliminary separation of the water. The method is shown to be capable of effecting large economies in practice.—E. **Rengade**: The theoretical form of the cooling curves of binary mixtures.—Marcel **Delépine**: The metallic iridio-sulphates.—A. **Guyot**: New general methods for the synthesis of aromatic aldehydes. The method is based on the condensation of a phenol, hydrocarbon, or amine with the $\alpha\beta$-diketonic esters of the type $X—CO—CO—CO_2R$.—Charles **Mauguin**: The acid properties of the halogen amides: the Hofmann migration. The sodium derivative of bromacetamide, $CH_3CO.NaBr$, has been isolated and its decompositions studied.—N. **Danaila**: The oxidation of the dimethylanilinisatins.—H. **Masson**: The composition of essence of cloves. To the principal constituents already known of essence of cloves it is necessary to add methyl salicylate and two aldehydes, α-methylfurfural and a dimethylfurfural.—P. A. **Dangeard**: The photographic properties of *Chlorella vulgaris*.—M. **Biot**: Concerning *Trypanosoma lewisi*.—M. **Glover**: The examination of the respiration and the graphical analysis of speech in special schools. The radioscopic examination of the thorax has been found of great value in examining the mode of breathing.—Paul **Hallez**: The biological cycle of a form nearly related to Otoplana.—P. **Hachet-Souplet**: The psychology of the Artiozoa.—Mlle. L. **Chevroton** and F. **Vlès**: The kinematics of the segmentation of the egg and the chronophotography of the development of the sea-urchin. An application of the method of Marey to the study of the embryonic development of an animal. A series of photographs is taken at equal intervals of time, and the long film, containing 7000 to 8000 images, examined in the kinematograph.—M. **Sarthou**: The presence in milk of an anæroxydase and a catalase.—M. **Billon-Daguerre**: A mode of integral sterilisation of liquids by radiations of very short wave-length. Geissler tubes, made of quartz, containing rarefied gases, give out rays of short wavelength which are twenty-five times more powerful in producing sterilisation than ordinary ultra-violet rays. Such tubes are more economical than mercury vapour lamps, requiring a primary current of 2 amperes at 4 to 6 volts.—E. **Gley**: The action of toxic serums and their antitoxins on the nervous system. Contribution to the study of the mechanism of immunity.—E. **Gley** and V. **Pachon**: The action of toxic serums on the isolated heart of animals immunised against these serums.

DIARY OF SOCIETIES.

THURSDAY, November 18.

Royal Society, at 4.30.—Bakerian Lecture: The Statistical and Thermodynamical Relations of Radiant Energy: Sir J. Larmor, Sec.R.S.

Linnean Society, at 8.—A New Tipulid Subfamily: W. Wesché.—Freshwater Rhizopods from the English Lake District: J. W. Brown.

Institution of Mining and Metallurgy, at 8.—The Development of Heavy Gravitation Stamps: W. A. Caldecott.—Experiments in Reverberatory Practice at Cananea, Mexico: L. D. Ricketts.

FRIDAY, November 19.

Institution of Mechanical Engineers, at 8.—An Internal-combustion Pump and other Applications of a New Principle: Herbert A. Humphrey.

MONDAY, November 22.

Royal Geographical Society, at 8.30.—A Naturalist's Travels on the Congo-Zambezi Watershed: S. A. Neave.

TUESDAY, November 23.

Institution of Civil Engineers, at 8.—*Further discussion*: The Single-phase Electrification of the Heysham, Morecambe and Lancaster Branch of the Midland Railway: J. Dalziel and J. Sayers.—The Equipment and Working-results of the Mersey Railway under Steam and under Electric Traction: J. Shaw.—The Effect of Electrical Operation on the Permanent-way Maintenance of Railways, as Illustrated on the Tynemouth Branches of the North-Eastern Railway: Dr. C. A. Harrison.

Zoological Society, at 8.30.

WEDNESDAY, November 24.

Royal Society of Arts, at 8.—Photo-Telegraphy: T. Thorne Baker.

British Astronomical Association, at 5.

THURSDAY, November 25.

Royal Society, at 4.30.—*Probable Papers*: On the Change in Hue of Spectrum Colours by Dilution with White Light: Sir William de W. Abney, K.C.B., F.R.S.—On the Nature of the Hydrogen Flocculi and their Structure at Different Levels in the Solar Atmosphere: Prof. G. E. Hale, For.Mem.R.S. and F. Ellerman.—The Boiling Point of Sulphur corrected by Reference to New Observations on the Absolute Expansion of Mercury: Prof. H. L. Callendar, F.R.S., and H. Moss.—(1) On the Refraction and Dispersion of Neon; (2) On the Refraction and Dispersion of Air, Oxygen, Hydrogen, and Nitrogen; (3) On the Refraction and Dispersion of Sulphur Dioxide and Hydrogen Sulphide, and their Relation to those of their Constituents: C. Cuthbertson and M. Cuthbertson.—On Flapping Flight: Prof. M. F. Fitzgerald.—The Crystalline Structure of Iron at High Temperatures: W. Rosenhain and J. C. W. Humfrey.—The Relation of Thallium to the Alkali Metals: a Study of Thallium-zinc Sulphate and Selenate: Dr. A. E. H. Tutton, F.R.S.—And other papers.

Institution of Electrical Engineers, at 8.—The Present Aspects of Electric Lighting: H. W. Handcock and A. H. Dykes.

FRIDAY, November 26.

Physical Society, at 5.—The Effective Resistance and Inductance of a Helical Coil: Dr. J. W. Nicholson.—Ductile Materials under Combined Stress: W. A. Scoble.—The Recoil of Radium C from Radium B: Dr. W. Makower and Dr. Sidney Russ.—The Sun's Motion with Respect to the Æther: Dr. C. V. Burton.

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THURSDAY, NOVEMBER 25, 1909.

THE "ORIGIN OF SPECIES" AND ITS LESSONS.

Charles Darwin and the Origin of Species; Addresses, &c., in America and England in the Year of the Two Anniversaries. By Prof. E. B. Poulton, F.R.S. Pp. xvi+280 and index. (London: Longmans, Green and Co., 1909.)

ON November 24, 1859, appeared the first edition of that immortal work—the outcome of twenty years' research—which was destined to revolutionise scientific thought, first in the domain of organic nature, and ultimately in every department of intellectual activity. The celebrations of the jubilee of this publication and of the centenary of the birth of its illustrious author, held at Baltimore in January, at Oxford in February, and at Cambridge in June of the present year, have been the means of directing public attention in such detail and in such forcible terms to the magnitude of Darwin's achievements and to the far-reaching consequences of his labours that it may well be doubted whether any further tribute can be paid to the memory of our great countryman. Nevertheless, on the present occasion, practically coincident with the fiftieth anniversary of the publication of the "Origin," it is only appropriate that we should direct attention in these columns to the latest contribution to Darwinian literature, the above work by Prof. Poulton, which the author has happily contrived to issue on the exact date of the anniversary. The readers of NATURE may be reminded that in these pages, to which Darwin himself was a rare contributor, some of the greatest questions raised by the publication of the "Origin" have been fought out by the leaders of science in that field of natural knowledge which, at the touch of what Helmholtz designated the "new creative thought," became reduced from a state of chaos to one of scientific order.

Of that generation of naturalists who were active workers before the publication of Darwin's book, there are but few survivors. Alfred Russel Wallace, to whom the present volume is appropriately dedicated, Sir Joseph Hooker and Sir Francis Galton are happily with us. But the later generations, who have been taught to accept organic evolution as an established doctrine, are apt to overlook the extent of their indebtedness to that memorable publication of Darwin's half a century ago. Before the appearance of that work the group of sciences now comprised under the general term Biology were still under the thraldom of an ancient cosmogony from which the physical sciences had been emancipated, if not completely at least to a very large extent. The year 1859 marked the beginning of what may fairly be described as the Reformation Period of biological science. At some future period, when the progress of knowledge shall have enabled a still later generation to obtain a just perspective of the bearing of Darwin's work upon the current thought of his time, a re-publication of some of the arguments that were urged against his teachings will furnish most instructive material for the historian of science. What impression would be produced now, for example, by a critic who in a scientific journal gravely opened an attack upon the "Origin of Species" with the remark:—

> "It will not be denied, we presume, that animals were created for the use of mankind. Man was to have dominion over them" (Edinburgh New Philosophical Journal, 1860, vol. xi., p. 283).

The reviewer concludes with a general appeal to the churches to unite in demolishing the new heresy.

The work now under consideration which has prompted the foregoing retrospection is by an author so well known as one of the soundest of the modern interpreters of Darwinism that a brief summary of its contents will suffice to commend the book to the serious consideration of all naturalists. More especially do we commend this, as also Prof. Poulton's other writings, to those who have caught up the cry, popular in some circles, that although evolution is established Darwinism is dead, or, to quote from the preface, to those who "recognize a prophet in every reed shaken with the wind." Of the seven chapters in this new memorial volume, the first ("Fifty Years of Darwinism") is revised and extended from the address given at the centenary in Baltimore in January; the second ("The Personality of Charles Darwin") is compiled from notes of a speech delivered on the same occasion; the third gives an account of the centenary celebration at Oxford and the speeches made on that occasion; the fourth gives the speech delivered by the author at the banquet at Cambridge in June, and the fifth ("The Value of Colour in the Struggle for Life") is reprinted from the Cambridge memorial volume, which was noticed in these columns at the time of the international celebration last June vol. lxxx., p. 481). Chapter vi., which will be new to most of our readers, is on the mimicry in the butterflies of North America, and is compiled from notes of the anniversary address delivered to the Entomological Society of America at Baltimore in December, 1908. The seventh chapter contains a number of letters written by Darwin to Mr. Roland Trimen and hitherto unpublished. As with all Darwin's correspondence, it is perhaps hardly necessary to say that these letters will be found most delightful reading, and their interest is enhanced by Mr. Trimen's own reminiscences of Darwin and by the recording of the most severe and perhaps the only severe thing that our magnanimous leader ever said of a scientific contemporary.[1]

In addition to these chapters, there are four appendices which are by no means the least interesting sections of the work. In the first of these, Darwin's views on the hypothesis of multiple origins are summarised, and in the second his conclusions with respect to what are now called "mutations" are marshalled in systematic order, and leave no doubt that this mode of evolution had over and over again been considered by him and always rejected as a *modus operandi* in nature. The mutation theory is happily paraphrased by Prof. Poulton in the preface as "based on the conception of an inborn transforming force violently discharged at regular intervals by every species of times past, present and to come"—a view on all fours with that upheld by the late Duke of Argyll, and which formed the subject of a criticism in these columns by the present writer at the time of its promulgation ten years ago (vol. lix., p. 217). It is the old "internal developmental force" let off sporadically instead of continuously, only subject, according to the founder of the theory, to control by natural selection.

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[1] The remark referred to (p. 28, note) is quoted from Prof. Poulton's article in the *Quarterly Review* of last July.

In the third appendix, as in his Oxford speech, the author refutes once and for all the absurd and unwarrantable conclusions respecting the mental degeneration due to the exclusive pursuit of science which certain writers have based upon Darwin's description of his declining artistic faculties with the advance of age. The last appendix is particularly striking, as it brings out for the first time a remarkable discrepancy between the views of the founder of the modern theory of mutation (de Vries) and certain English supporters of that theory (Bateson and Punnett) respecting the fundamental question of the transmissibility by inheritance of individual differences or "fluctuations." According to de Vries these fluctuations are transmissible; if they are not, the whole fabric of the Darwinian theory is, it is needless to point out, overturned. The elucidation of this point seems to be one of the most urgent problems awaiting attack by experiment.

The valuable contributions to the Darwinian theory with which the author of the present work has been for so many years identified have been mainly in that most fascinating field of the relationship between the colours of animals and their environment—a subject which first led the present writer to the serious study of the "Origin of Species" more than thirty years ago. In this class of phenomena, adaptation is obvious to those who do not wilfully close their eyes to the evidence. If this adaptation is not explicable by natural selection, then that principle can be applicable in no other department of organic nature. It is not going too far to say that with the proof or disproof of the utility of these resemblances in colour, form, pattern and habit which are so abundant in the insect world, the whole question of the validity of the Darwinian theory is bound up. Darwin himself foreshadowed this application; so also did Wallace. Bates, Wallace, and Roland Trimen applied it to mimetic resemblances, Thomas Belt was a contributor, and Fritz Müller in 1879 gave us a new and important lead. Its application to the development and use of the markings of caterpillars was among the early and by no means least important of the contributions to biological science by August Weismann. No writer in modern times has done more than Prof. Poulton to place this application of Darwin's theory upon a sound scientific basis, and not the least interesting of his contributions is to be found in the sixth chapter of the present work, wherein he traces with masterly hand the mimetic influence exerted by certain Old World butterflies upon the insects of the New World into which they are comparatively recent immigrants. Such a clear case as this, in which the direction of modification is not open to doubt, disposes at once of the theory that similar environmental influences produce similarity of colour and pattern, for here it is the old inhabitants of the country and not the later immigrants that have been modified in the direction of mimetic resemblance.

It may be permissible on the present occasion to extend one's contemplation of the book immediately under notice to certain wider considerations which arise from the work which has for so many years been carried out in the Hope Department of the University of Oxford. That work bears throughout the stamp of Darwin's influence, and stands as living testimony that the central doctrine proclaimed in the "Origin of Species" half a century ago is still a vitalising power. It will not be considered presumptuous to recommend to a generation which has been told that the species question is not even ripe for discussion a critical re-perusal of Darwin's classic. Thereby it will be made evident that for the author of that work, nature was a living whole—a frame of mind from which modern specialisation is unfortunately leading many of the younger workers astray. The breadth of view which enabled the author of the "Origin" to mould whole branches of science into his service must for all time be a matter for admiration and wonderment. How comprehensive that view really is may be inferred from the circumstance that there is scarcely one modern development of the species question—perhaps none with the exception of the long neglected work of Mendel—which in principle, if not in detail, is not foreshadowed in the "Origin." Even the all-important question of the transmission of acquired characters appears to have been raised, and to have been considered by Darwin, as may be gathered from an apparently forgotten passage in the "Origin" to which the writer has directed Prof. Poulton's attention, and which is quoted fully in the last appendix to the volume under consideration (p. 273).

Some other lessons conveyed by Darwin's "Origin of Species" may perhaps be worthy of consideration at the present time. We have heard much of late years about the want of public interest in science being due to the technical and popularly unintelligible language in which investigators express their results. The answer to that charge can best be given by pointing to Darwin's writings as a whole; these, although scientific in the technical sense, being nevertheless popular in treatment and commanding a sale never before realised by any set of treatises on purely scientific subjects. From this experience it is fair to conclude that unintelligibility is at any rate not a necessary accompaniment of sound scientific exposition.

The tendency to specialisation which is becoming more and more characteristic of modern scientific work is not in itself an unhealthy sign. It is the necessary consequence of the growth of knowledge on the one hand and of the limitation of the human intellect on the other. All the good work turned out by our investigators at the present time is the result of such specialisation. As time goes on, the increase in the mass of material and in the number of workers must reduce still further the limits within which the individual worker can hope to make substantial contributions to the knowledge of his subject. The danger to be guarded against is the unhealthy development of the effects of specialisation. Although it may no longer be possible to obtain a comprehensive grasp of a whole group of sciences, there still remains the lesson conveyed to the scientific world by Charles Darwin's work—that extreme concentration upon one particular investigation need not produce mental atrophy in other directions. There may be a narrowness of outlook produced by extreme specialisation which, if not guarded against, may easily pass from mere narrowness to actual illiberality of mind. This in its way is quite as unscientific, as it is certainly more dangerous in its immediate effect upon our younger contemporaries, as the shallowness arising from too great a diffusiveness.

R. Meldola.

ALPINE HYDROLOGY.

Service d'Études des grandes Forces hydrauliques (Région des Alpes.) Tome iii. Résultats des Etudes et Travaux au 31 Décembre, 1907. Pp. 688; with maps, photographs, and diagrams. (French Ministry of Agriculture, 1908.)

IN May of last year (vol. lxxviii., No. 2010) there were reviewed in these columns two volumes rendering an account of the initiation of a hydrological service in France, formed for the purpose of studying the rivers and watercourses of that country, which were capable of developing power for, and otherwise benefitting, industrial and agricultural pursuits. The purview of the inquiry was to be restricted, in the first instance, to the region of the Alps, to be extended later to the Pyrenees, and ultimately, no doubt, to include the Vosges and the hilly districts of the north and west. At the time of the issue of the volumes in question, the results of these investigations were only forthcoming in systematised form so far as the close of the year 1905, and operations had been confined to a certain portion of the Alpine watershed, the work being carried out under the supervision of two engineers, MM. de la Brosse and Tavernier, the former of whom reported on the basins of the Arve and the Isère, and the latter on the regions of the Durance and the Var.

The book before us is the third volume of the series, and it forms a compendium of figures and statistics no less impressive than its predecessors. It continues the account of the studies prosecuted by M. de la Brosse during the years 1906 and 1907. These relate to the northern district of the Alps, included between the bed of the Rhone and the Italian frontier on the one part, the Lake of Geneva and the basin of the Durance on the other part.

The southern district, from the basin of the Durance to the Mediterranean littoral, under the direction of M. Tavernier, is to form the subject of a subsequent volume.

M. de la Brosse commences his report with an enumeration of the gauging stations within his district of 26,000 square kilometres (10,000 square miles), showing that they have increased in number from 30 in 1903 to 60 in 1905, and to 100 at the present time. The number of separate gaugings taken in 1907 was more than a thousand. Nearly all the stations, he remarks, are of the foot-bridge type, the exceptions being in watercourses of considerable width, where barges were employed, and in places of considerable difficulty of access, where the only available method was to employ a skiff suspended from a cable fixed at some suitable level. The footbridge, from its greater security and convenience, proved by far the best system, and a number of interesting photographs show the variations in design at different stations to meet local peculiarities.

The instruments used for gauging were described in some detail in the first volume, and the only comments now made in connection with them, after some experience of their working, relate to a few trifling modifications and minor improvements in design. A calibrating station for testing current-meters was established at Grenoble in 1906, and this has been found a considerable convenience, as, prior thereto, the instruments had to be dispatched to the hydrotechnical laboratories of Berne or Munich.

The station in question comprises an electrical apparatus, mounted on a framed platform, set in a quiescent sheet of water forming part of a fortification moat. The apparatus is actuated by a triphase motor of 5 horse-power, which enables various degrees of speed to be imparted to a movable arm carrying the instrument to be tested, ranging from a few centimetres to nearly 5 metres (say, an inch to 16 feet) per second. By a circuit connection the number of revolutions of the screw is signalled at periods of from 25 to 50, and a simple calculation therefrom determines the relative speed in a moving medium. The process requires the services of two operators and two assistants, lasts from one to two hours, and (including the cost of the electric current) involves an expense of 1*l.* per instrument dealt with.

During the two years 1906–7, surveys have been made of the basins of the Dranses, the Usses, the Fier, the lake of Bourget, the Guiers, the Bourbre, the Gère, the Collières, the Galaure, the Drôme, the Roubion, the Lez, and the Eygues, all tributaries of the Rhone, and comprising an area of 918,643 hectares (2,300,000 acres). These basins are all separately delineated in the volume under review in a series of charts to a scale of 1/200,000, which are accompanied by tables recording various analytical particulars of the component sections, according to superficies and altitude.

A noteworthy feature of several of the smaller basins (especially that of the Collières) is the disappearance and reappearance of streams in and from subterranean passages, resulting oftentimes in several changes of name for a single watercourse, the identity of which can be established without serious difficulty throughout its apparently disconnected track. For example, the same waters feed successively the Reval, the Orou, and the Collières, which thus constitute really a single stream.

An interesting extension of these topographical investigations has been made in reference to some of the principal glaciers, which the commission rightly regard as important reservoirs. The glaciers of Vallouise were surveyed in 1904, those of the Grandes Rousses in 1905, and the glacier of Mont de Lans in 1906–7.

It would be impossible within the limits of a short article to touch upon all the points of interest in M. de la Brosse's report, and the foregoing constitute simply a few random notes culled from pages which are replete with valuable information on all branches of hydrographical research amid the Alps. Mention must, however, be made of two supplementary notes by M. Mougnié, of Moutiers, the first on the subject of controlling the discharges of the Isère, and the second on variations in the bed of the same river. Then follows the second part of the volume, a compendium of more than 600 pages of tabulated data covering the whole area of operations.

The admirable manner in which these observations are being made and recorded reflects the highest credit on the Direction de l'Hydraulique, and abundantly justifies its formation and support. It is evident that there is being collected a wealth of data which must prove of incalculable value in estimating the hydrological resources of the country and in utilising them to the best advantage and to their fullest extent. Further volumes of the series will be awaited with undiminished interest by all who are concerned in any way in the development of hydrotechnical studies.

B. C.

THE SCIENCE OF PATHOLOGY.

The Principles of Pathology. By Prof. J. George Adami, F.R.S. Vol. I., General Pathology. Pp. 948. (London: Henry Frowde and Hodder and Stoughton, 1909.) Price 30*s.* net.

WE congratulate Prof. Adami on the completion of this exhaustive work, of nearly 1000 pages, on general pathology, more particularly as he had the misfortune to lose his library, the manuscript of the concluding chapters, and the illustrations collected over a period of many years for the purposes of the book, in the fire by which the medical buildings of McGill University were destroyed in April, 1907.

The book is divided into three sections, section i. dealing with prolegomena, and in particular with the cell and its relation to disease, section ii. with the causes of disease, and section iii. with the general morbid and reactive processes.

In the opening chapters an excellent summary is presented to the reader of the various theories of cell structure and connections, and of the physiology and chemistry of the cell, including enzymes and their mode of action. In these considerations the author adapts the "side-chain theory" to explain the relationship of the protein molecule to life and metabolism and to enzyme action. Whether correct or no, this conception has the advantage of visualising the subject, and gives the student concrete ideas which he can grasp, in place of abstract ones.

Growth, states of cell activity, cell multiplication, adaptation, and differentiation are next considered, and the important subject of inheritance has, rightly, considerable space devoted to it; and Mendel's and Galton's laws, mutations, and the inheritance of acquired characters all receive adequate treatment.

Having thus cleared the ground by a consideration of these general biological problems, the author passes on to the subject-matter proper, commencing with a discussion of the causes of disease, in which inheritance is again considered, and the various anomalies of development and the monstrosities are very fully described. The bacterial, protozoan, and metazoan parasites are then discussed, but only in a general way, as causes of disease—a wise limitation, as the parasites themselves and their general biology and activities are fully described in various other textbooks. Referring to the presence of bacteria potentially pathogenic in and upon the healthy body, the author mentions that streptococci are present in the mouth in 80 per cent. of healthy people, but it is to be noted that Gordon has shown that the species present in the mouth, and so abundant there, is non-pathogenic, and differs from the disease-producing streptococci.

In the section on malaria it would have been more correct to speak of "anopheline" rather than "anopheles," mosquitoes as agents of transmission.

Chapter xi. is devoted to endogenous intoxications due to abnormalities of internal secretion (*e.g.* of the thyroid, adrenals, pancreas, &c.), which, it is true, gives the essentials of the subject, but fourteen pages seem to us inadequate space in a work of this kind to discuss so important a subject.

In the section on the morbid and reactive processes, the local and systemic reaction to injury and inflammation are dealt with very fully, and altogether in a judicious and instructive manner. Immunity and its various problems are similarly well treated, and a survey is given of every branch of the subject; Ehrlich's "side-chain theory" in particular is well described, and at some length. As regards anaphylaxis—the *increased* susceptibility conferred by an injection of blood-serum—we cannot help thinking that the suggested explanation is laboured, and, involving as it does the ionic hypothesis, beyond our present knowledge of the phenomenon.

The progressive tissue changes—hypertrophy, regeneration, and new growths—are next discussed in a very complete manner. We are glad to note that the author emphasises the futility of attempting to graft the tissues of lower animals on man for purposes of repair.

In speaking of placental moles, the inexact, if not incorrect, appellation "hydatid" is retained; "hydatidiform" is preferable.

The characters of neoplasms (tumours or new-growths) are given at considerable length. The classification of neoplasms adopted is the histogenetic one supported by the author. A principal objection urged by Prof. Adami against the embryogenetic classification is that it separates new growths histologically similar, *e.g.* glioma of epiblastic, and sarcoma of mesoblastic, origin. We venture to think that too much stress should not be laid on this argument, for even now the minuter structure of new growths is only beginning to be studied. Nor are we as yet absolutely certain of the developmental origin of many structures in the body, and further research may clear up some of the apparent discrepancies now incidental to the embryogenetic classification. The histogenetic classification itself is not altogether free from the reproach levelled at the embryogenetic one by Prof. Adami.

As regards the genesis of new growths, the various hypotheses are discussed at considerable length, and an admirable survey of this vexed and complex question is presented to the reader. Prof. Adami considers that no parasitic hypothesis suffices, that Beard's hypothesis of aberrant and misplaced germs and trophoblastic cells (so much in evidence lately in connection with a certain form of treatment) is inadequate, seeks for an explanation in the hypothesis of a change (? a mutation) in the biological properties of the cells giving origin to tumours, and considers that there is no one specific cause; with all these we cordially agree.

The concluding portion of the book deals with the regressive changes, the degenerations and infiltrations, calcification, pigmentation, &c. The book altogether is an inspiring one, and the careful reader will not only gather what is already known, but will be led to infer in what directions further progress lies. A notable feature of it is the attempt made, usually successfully, to ensure a basis on a sound foundation of general biology. It is carefully and adequately illustrated, and the numerous diagrams and schemata serve to render many of the more abstruse conceptions clear and intelligible.

A NEW WAY IN ARITHMETIC.

Theorie der algebraischen Zahlen. By Dr. Kurt Hensel. Erster Band. Pp. xii+350. (Berlin and Leipzig: Teubner, 1908.) Price 14 marks.

IN this volume Dr. Hensel gives the first instalment of a treatise on algebraic numbers, embodying an independent method on which he has been engaged for the last eighteen years. Its leading idea may be illustrated by the following example. Let us take the solvable congruence, $x^2 \equiv 2$ (mod. 7), the roots of which are $x \equiv 3$ and $x \equiv 4$. The same congruence can be solved with respect to the moduli 7^2, 7^3, 7^4, &c., and we obtain the solutions, in least positive residues, (3, 4), (10, 39), (108, 235), (2116, 285), and so on. Taking the first number in each bracket and expressing it in the septenary scale, only writing the digits in the reverse of the usual order, we obtain the associated solutions, 3, 31, 312, 3126; and it is clear that if $x = a_1 a_2 \ldots a_n$ is a solution of $x^2 \equiv 2$ (mod. 7^n), we can find a number $a_1 a_2 \ldots a_n a_{n+1}$, which is a solution of $x^2 \equiv 2$ (mod. 7^{n+1}). There is thus a definite sequence of digits, 3, 1, 2, 6, . . . a_n, . . . such that each is a least positive residue of 7 (or zero), and such that 3126 . . . a_n is a solution of $x^2 \equiv 2$ (mod. 7^n). This sequence may be said to be the symbolical septenary representation of $\sqrt{2}$. But conversely we may take any such sequence, $a_1 a_2 \ldots a_n \ldots$ and define it as a septenary number, in an extended sense. All such numbers form a corpus, provided we introduce septenary fractions of the same type. Since $-1 \equiv (7^n - 1)$ (mod. 7^n), the symbolical form of -1 is 666 . . . or $\dot{6}$; hence every ordinary positive or negative integer or fraction has a symbolic expression which is wholly or partly periodic, *e.g.* $2/3 = (3+\dot{6})/3 = 3\dot{2}$, and so on. Similar results hold for any prime modulus; when the modulus is composite, some curious anomalies occur.

Now let $w_1, w_2, \ldots w_n$ be a basis of an algebraic corpus; we may form symbols of the type $A_1 w_1 + A_2 w_2 + \ldots + A_n w_n$, where $A_1, A_2, \ldots A_n$ are numbers of the kind just described. These new symbols may be called "numbers," and by making use of them Dr. Hensel obtains all the most important known properties of algebraic numbers with surprising facility; he also adds results of his own which are of great interest and beauty. Calling a symbol such as A_1 a p-adic number, we may call $F(x) = A_1 x^n + \ldots + A^n$, a p-adic function; it is shown how to determine, by a finite process, the irreducible p-adic factors of $F(x)$, and by a series of propositions we are led up to the remarkable theorem (p. 159) that if $f(x) = x^\lambda + a_1 x^{\lambda-1} + \ldots + a_\lambda$, the coefficients being integral p-adic numbers, and $f(x)$ irreducible, then if p^δ is the highest power of p which divides the discriminant of $f(x)$, and if α_1 is a root of the ordinary equation

$$\phi(x) = 0$$

obtained from $f(x)$ by omitting all the digits of $a_1, a_2, \ldots a_\lambda$ beyond the $(\delta - 1)$th place, the equation $f(x) = 0$ will have precisely λ conjugate roots $\xi_1, \xi_2, \ldots \xi_\lambda$ expressible as conjugate p-adic numbers in the corpora (α_1), $(\alpha_2) \ldots (\alpha_\lambda)$. This fundamental fact leads to a host of consequences, among them a comparatively simple treatment of a well-known problem, namely, the resolution into their prime ideal factors of the real primes which divide the discriminant of a given corpus. It also leads to a complete theory of congruential roots of unity; the theory of units in a given corpus is not discussed in this volume.

On pp. 308 and following will be found a complete solution of the problem of resolving a given real prime into its ideal factors within a given corpus; this involves the Kronecker method, in which *umbrae* are used, and probably there is no certain practical way which can dispense with them. As an illustration, it is shown that in the corpus defined by the equation $\alpha^3 - \alpha^2 - 2\alpha - 8 = 0$, the number 2 is the product of three ideal primes, which are actually determined.

One of the last theorems proved in this volume may be stated in the following terms:—If a corpus is defined by an equation $f(x) = 0$, which is not Galoisian in the field of ordinary numbers, we cannot make the field Galoisian by the introduction of p-adic numbers.

The value of the treatise can hardly be overrated, and its completion will be anxiously expected. It is interesting to compare it with Hensel and Landsberg's treatise on algebraic functions, and observe the points of contact. A special feature is that in the arithmetical work, like the other, there are expansions in fractional powers; in the algebraic theory it is almost impossible to avoid this, except by tedious divagations, but in the theory of numbers such symbols ought to be avoided if possible, and their occurrence here may cause some readers a shade of regret. G. B. M.

LISSAJOUS'S FIGURES.

Harmonic Vibrations and Vibration Figures. By J. Goold, C. E. Benham, R. Kerr, and Prof. L. R. Wilberforce. Edited by H. C. Newton. (London: Newton and Co., n.d.) Price 6*s.* net.

THE four authors of this book have each contributed an account of the construction and use of apparatus which they have invented or brought to perfection, the several parts of the book being independent of one another, but related by the similarity of the subject-matter. Lissajous's figures were originally introduced as a convenient method of illustrating optically or mechanically acoustic phenomena, but the beauty and perfection of the results obtained by the compound pendulum of Tisley, and later by the twin elliptic pendulum of Goold, have made the subject sufficiently attractive to be pursued for its own sake. As two leading scientific publishers declined to take the book on the ground that it could not pay, we are indebted to Messrs. Newton and Co. for rescuing and producing a book which will be valued in many quarters.

Mr. Benham writes the history of the harmonograph, and describes his own triple pendulum and his own modification of Goold's twin elliptic pendulum. He also gives valuable information to anyone who would construct his apparatus as to the details which are necessary for success. The construction of the ruling pen, choice of inks or dyes, the selection of suitable paper, interesting dodges with photographic plates or with successive chemicals, are a few only of the tips or dodges described. The extremely beautiful stereoscopic effects obtained by viewing two nearly identical harmonograph figures with a stereoscope are described and illustrated, as is the curious change which occurs when such a pair of figures are slowly turned round at the same time, so as to change their relative aspect, the series of lines all appearing on the surface of a cylinder in the one position, and gradually merging into a series, each of which lies between the last one and the axis in the other position. In the case of figures drawn by the twin elliptic pendulum, where it would be next to impossible to draw two successive figures which should be sufficiently alike, the ingenious plan is adopted of selecting those which have a two-fold symmetry, but in which the two halves on opposite sides of the centre are not quite identical, and then simply turning one upside down, in order to obtain stereoscopic shell-like structures of wonderful beauty. Several examples of the marvellous beauty of the twin elliptic pendulum's work are given, in which it is difficult to know whether the forms of the curves or the water-mark patterns are the more to be admired.

Visitors at soirées of the Royal Society will remember the curves drawn by Mr. Goold's big twin elliptic pendulum, as also that queer vibrating and droning steel plate, which gave rise to so many curious phenomena. One passage from Mr. Goold's description may here be quoted.

> "If . . . a small chain be thrown on the vibrating plate, it will immediately settle itself on the curved line between the vortices and . . . will crawl away to the nearest vortex, and there coil itself up like a serpent, continuing to rotate as long as the plate remains sufficiently excited."

This is one only of a number of curious results obtained by Mr. Goold.

Mr. Richard Kerr describes a form of geometric pen, capable of producing very beautiful patterns. This is followed by an account of Mr. Lewis Wright's method of projecting Lissajous's figures on a screen, using reeds in the place of tuning forks, and Prof. Wilberforce describes his well-known sympathetic vibrations obtained by the aid of one or two torsion springs.

This is an excellent book for the Christmas holidays.

C. V. BOYS.

OUR BOOK SHELF.

Cattle of Southern India. By Lieut.-Col. W. D. Gunn. Department of Agriculture, Vol. III., Bulletin No. 60. Pp. 65; plates. (Madras: 1909.) Price 3*s.*

ALTHOUGH the existence of a number of local breeds and sub-breeds of Indian humped cattle (*Bos indicus*) is familiar to Anglo-Indians, comparatively little is known about them in this country, and it is, therefore, highly satisfactory that Col. Gunn, Superintendent of the Indian Civil Veterinary Department at Madras, has furnished us with this elaborately illustrated account of the various types to be met with in southern India. It is, however, a matter for regret that the author did not see his way to make his work complete by including the breeds found in other parts of India. As to the origin of humped cattle, the author is silent, and perhaps wisely so, since, so far as we are aware, nothing definite has hitherto been ascertained with regard to this subject.

If we rightly understand him—and his classification is by no means so clear and unmistakable as it might be—the author considers that there are two main types of large-humped cattle in southern India, namely, the Mysore and the Ongole, or Nellore. The former, which are characterised by the long, more or less upwardly directed, slightly tapering horns, and generally iron-grey or bluish colour, are, however, divisible into a number of sub-breeds, such as the Amrat Mahal, Hallikar, Alumbadi, &c., all of which come under the native designation of Doddadana, or large cattle, in contradistinction to the Nadudana, or ordinary small village cattle. The finest of all are the cattle of the Amrat Mahal breed, which were formerly owned by Tippu Sultan, but became the property of the British Government after the fall of Seringapatam, although the management of the herds remained for a time under the control of the Maharaja of Mysore, on condition of his supplying a specified number of bullocks. In the old days of Indian warfare these cattle were of the greatest value for transport-purposes on account of their rapid pace.

The Nellore, or Ongole, cattle, on the other hand, carry short and somewhat stumpy horns, which are, however, longer in cows than in bulls, and have an outward and slightly backward direction. Formerly black-and-white was in fashion, but white is now the favourite colour for these cattle, the ears of which droop more than in the Mysore type. Although probably less hardy than the Mysore breeds, these cattle are unsurpassed for slow work, a pair, it is stated, being capable of drawing a load of five tons.

The volume closes with a notice of the domesticated buffaloes of southern India, special mention being made of the Toda customs associated with the cult of these animals.

R. L.

Flora of Cornwall. Being an Account of the Flowering Plants and Ferns found in the County of Cornwall, including the Scilly Isles. By F. H. Davey. Pp. lxxxviii+570. (Penryn: F. Chegwidden, 1909.) Price 21*s.* net.

ON account of its extreme situation, the mildness of the climate, and the interesting rock formations, notably round the Lizard, the county of Cornwall exercises a great fascination for students interested in natural history. It is rather strange, therefore, that a county flora should only now be compiled, especially as many botanists—natives, aliens, and others—have found it a profitable hunting ground. Six years ago Mr. Davey published a preliminary list of plants which was deserving of the title of a flora, but this was only intended to form a basis for a more complete survey and to arouse interest in the undertaking; the intention has been entirely successful, and the author's subsequent labours, assisted by energetic and able co-workers, have culminated in the volume under notice, in which the total number of plants is computed at 1180; and of these, 953 are considered to be native.

The greater part of the book is devoted to the enumeration of species, with detailed list of localities for all but very common plants; in this matter the author has been over-bountiful, and space could have been saved by the elimination of the long list of localities for certain species that are in no sense critical, such as *Spiranthes autumnalis* or *Centranthus ruber*. The number of species found in Cornwall, but not recorded for any other county in Britain, amounts to twenty, while a comparison with Devonshire shows that fifty-three plants growing in Cornwall have not been collected in Devonshire, as against 103 confined to the latter county.

A considerable part of the introduction is given up to a history of botanists who have contributed to the county records, and a few photographs of notable local botanists are included; there is also a short account of eight botanical districts which are indicated on an accompanying map, and a list of a few plants peculiar to each, but the author has not attempted an ecological sketch of the chief formations. Among the Cornish botanists the best-known name is that of the Rev. C. A. Johns, the author of "Flowers of the Field" and "A Week at the Lizard," while William Curnow, T. R. Archer Briggs, and Richard Tellam were even more zealous field workers. Mr. Davey, too, has added his quota of records, for which he deserves to rank among the honoured list of local botanists, as also for the strenuous work in connection with this publication. The volume is worthy to rank with the standard county floras, more particularly in the verification of records and critical compilation.

The Elements of Animal Physiology. By Prof. W. A. Osborne. Pp. 152. (Melbourne: Thomas C. Lothian, 1909.)

THE size of this little book will indicate that it contains a mere sketch of the large subject of which it treats. It is written for the purpose of supplying non-medical readers with an introductory account of mammalian physiology, in the hope that they subsequently will take up the question more fully. Prof. Osborne has in Melbourne to teach students of agriculture and veterinary science, in addition to those who are taking full medical or science courses, and it is to the former class of students that the work is specially addressed. One can hardly doubt that agriculturists, especially in Australia, where the breeding of domestic animals forms such a large part of their work, will benefit greatly if they have a rational substratum of physiological facts at their disposal.

The book is trustworthy and free from errors; it is specially full on its biochemical side, which is what one would anticipate from Prof. Osborne's research work. Complex questions, such as those dealing with the nervous system, are treated with extreme brevity, and this is to be regarded as judicious, seeing what class of readers are specially catered for. We wish the book the success it deserves.

A Text-book of Experimental Physiology for Students of Medicine. By Dr. N. H. Alcock and Dr. F. O'B. Ellison. With a preface by Prof. E. H. Starling, F.R.S. Pp. xii+139. (London: J. and A. Churchill, 1909.) Price 5*s.* net.

To some extent this little book is the outcome of a conference of the London teachers of physiology. They have for long felt that a revision of their practical courses was necessary, and the present work, which is issued under the ægis of Prof. Starling, indicates the kind of reform considered desirable. One understands that in the future the practical examinations in the University of London, at any rate, will be largely modelled on the kind of course here presented. The main underlying new idea is that medical students should be taught physiology so as to fit them for being, not expert pure physiologists, but medical men with a knowledge of those portions of the vast subject which will be immediately useful to them in their study and treatment of diseased conditions. The frog is therefore relegated to a position of subsidiary importance, and as many experiments as possible are given in which the mammal, and especially man himself, is the *corpus vile*. It would be ungracious at this stage to point out faults of omission and commission of which the authors, Drs. Alcock and Ellison, have been guilty in their praiseworthy attempt to carry out the new idea. It will only be possible to do so when the book has been tried as a practical guide, and future editions will no doubt, show various improvements, after the present one has been subjected to this test.

W. D. H.

Elementary Photo-micrography. By Walter Bagshaw. Second edition. Pp. 103. (London: Iliffe and Sons, Ltd., 1909.) Price 2*s.* 6*d.* net.

THE object of this little book is to arouse interest in, and give instruction to, those to whom such a study would otherwise possibly appear far too abstruse and full of difficulty. It is most clearly and lucidly written, and there is an evident desire to avoid unnecessary detail. It would be easy to criticise and to point out the many omissions of essential detail that to an advanced worker are only too obvious; but it must be admitted that for the beginner and intelligent worker the instructions would prove, in the majority of cases, ample. Nearly the whole of the course of work suggested may be carried out with simple apparatus: in fact, it is much to the credit of the writer that simplicity, and the absence of any recommendation to use complex apparatus, is the keynote of the entire book. It is perhaps to be regretted that, having gone so far, he has not in some directions slightly extended the work. The instructions in the use of the microscope itself are perhaps unnecessarily meagre, whereas such matter as a list of photographic chemicals required, with the prices—information that can be obtained from any trade catalogue—might easily have been omitted. On the whole, however, the object of the book is fulfilled, and it will form, to those who have a microscope of simple construction, or who, having a camera, wish to apply it for microscopic work as well, a most useful guide. The illustrations are in all cases of a high order, and have been selected, not merely as pictorial examples of photo-micrographic work, but, so far as possible, to bring home to the student the difficulties to be encountered and the results to be attained.

J. E. BARNARD.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Inheritance of Acquired Characters.

IN reviewing Prof. Eigenmann's book on the cave vertebrates of America (NATURE, November 11, p. 40), the reviewer quotes the author's opinion that "The bleached condition of animals living in the dark, an individual environmental adaptation, is transmissible, and finally becomes hereditarily fixed. . . . Natural selection cannot have affected the coloration of the cave forms, for it can be of no consequence whether a cave species is white or black." Your reviewer further dismisses Romanes's supposition that colour may be correlated with other structures which are subject to selection.

Is it not probable that the *mere cessation* of natural selection with regard to colour would produce this colourless condition quite apart from light or other environmental factor?

In the silkworm-moth, *Bombyx mori*, we have a similar absence of colour in both moth and larva, solely, I take it, because no attention has been paid to the colour of either during the many centuries that the species has been *selected for its silk-producing qualities* alone under semi-domestication.

While on this subject, I may perhaps refer to Mr. Wm. Wood Smyth's letter in NATURE of May 6 last (vol. lxxx., No. 2062, p. 277), with reference to the drone breeding habits of some workers of the hive bee affording a possible channel for use inheritance in regard to neuter characters.

I had hoped that this important point would have been the subject of further correspondence by the acknowledged authorities on apiculture.

I thought that this feature of egg-laying workers was, as a rule, confined to queenless hives that were more or less *in extremis*. Presumably the habit would be subject to heredity, and if, as I understand, it is not only a detriment but a source of danger to any community of bees to have any number of egg-laying workers, it seems reasonable to suppose that in wild stocks such a habit would be so stringently restricted by natural selection as to deprive its occasional occurrence in domesticated stocks of any significance in the production of the structural differences or special habits which differentiate workers from queens. It would be of very great interest to know if neuter ants of any species retain the power of laying occasional eggs.

A. BACOT.

MR. BACOT's suggestion with regard to the cessation of natural selection in relation to the bleaching of cave animals has been fully dealt with by Prof. Eigenmann himself in the work under review. It will be only fair to Prof. Eigenmann to quote his own words:—"Panmixia can not account for the discharge of the colour, since it returns in some species when they are exposed to the light and disappears to a certain extent in others when kept in the dark. Panmixia, Romanes thinks, may have *helped* to discharge the colour. In many instances the colour is a protective adaptation, and therefore maintained by selection. Panmixia might in such instances lower the general average to what has been termed the 'birth-mean.' *Proteus* is perhaps such an instance. But in this species the bleached condition has not yet been hereditarily established, and since each individual is independently affected, 'the main cause of change must have been of that direct order which we understand by the term climatic.' Since, however, the bleached condition, which in the first instance is an individual reaction to the absence of light, has become hereditarily established in *Amblyopsis* so that the bleaching goes on even when the young are reared in the light, it is evident that in *Amblyopsis* we have the direct effect of the environment on the individual hereditarily established."

If Mr. Bacot will read the notice again he will see that the reference to "Romanes's supposition that colour may be correlated with other structures which are subject to selection" is a quotation. The reviewer still considers, however, that Prof. Eigenmann has made out a strong case.

ARTHUR DENDY.

Radio-activity and the Rocks.

MR. F. P. MENNELL, in NATURE of November 18, raises the question whether the more strongly active of the rock-forming minerals owe their activity to thorium. I have a considerable number of data on this subject obtained by direct experiment, estimating radium and thorium by their emanations. I find, by this method, that zircon, sphene, and apatite usually contain some thorium, but that it generally contributes less to the activity than the substances of the uranium-radium series.

R. J. STRUTT.

Imperial College of Science, South Kensington,
November 20.

The Auroral Display of October 18.

THE aurora of October 18 was observed at Allegheny Observatory under conditions somewhat similar to those mentioned by Mr. Ernest Baty in NATURE of October 28 (vol. lxxxi., p. 518). Here, however, the whole sky was dull, hazy, and cloudy at the beginning of the display, gradually clearing toward midnight. No stars whatever could be seen in the region covered by the aurora, which was very bright. This fact might lead us to think that it had its origin in the lower layers of the atmosphere.

The aurora consisted of the usual arch, from which arose streamers at various points, some of them extending to an altitude of about 45°. These drifted westward and gradually diminished in brightness, while they were followed by others in rapid succession. The streamers had at times a reddish tint.

The aurora was still faintly visible at 1 a.m., by which time the sky had become perfectly clear.

F. C. JORDAN.

Allegheny Observatory, Allegheny, Pa.,
November 9.

Large Flying-fish.

A FLYING-FISH flew on to the lower deck last night about 8.30 p.m. The deck is 20 feet above the water-line, and the railing is 4 feet 6 inches above the deck, but it is possible for it to have flown through the railing; the fish measured 17¼ inches from tip of nose to tip of tail. I forgot to weigh it before it was cooked. It was the largest flying-fish I have ever handled. Could any reader of NATURE kindly inform me what is the largest size known? We were about fifty miles north of Teneriffe when it came on board. The species up here appear to be larger than those in the tropics and near South America. I have seen large ones in the Gulf of Aden, but never caught one, though I am inclined to think this was a larger species. The longest flyers always appear to be the largest fish: the longest flight I have seen has been about 400 yards.

C. HOWARD TRIPP.

S.S. *Kaipara*, October 15.

SPINAL ANÆSTHESIA.

The visit of Prof. Thomas Jonnesco, of the University of Bucharest, to the Seamen's Hospital, Greenwich, has brought prominently before the public the method of producing local anæsthesia by the injection of anæsthetic solutions into the spinal canal.

Cocaine was introduced years ago as an anæsthetic for local application; it was welcomed by the medical profession, and equally by patients, on account of its invaluable services in operative procedures upon the eye, the nose and the throat. By merely placing a drop or two of a solution of cocaine (or one of its salts) into the eye, or by painting a similar solution upon the mucous membrane of the nose or throat, it is possible to produce anæsthesia so complete as to enable surgical operations to be performed upon these parts without inflicting the least pain or discomfort upon the patients. Certain objections to the use of cocaine were not long, however, in showing themselves. Cocaine is a powerful alkaloid; and if the usual dose be exceeded, very grave results follow, a number of patients having actually died as the result of cocaine poisoning. Investigators were therefore led to search for other substances, either like cocaine occurring naturally, or prepared synthetically, which would possess the properties of cocaine while being less poisonous.

In this way a number of anæsthetic drugs has been introduced, including alypin, holocaine, eucaine (alpha and beta), scopolamine, novocaine, stovaine and tropacocaine. Of these the three latter have been chiefly employed in producing spinal anæsthesia. The method consists in injecting, by means of a syringe and needle, a quantity (usually about 1 c.c.) of a solution of one of these substances into the spinal canal. The injection is made in the back, close to the middle line, the needle being inserted between two of the vertebræ. With regard to the details of the method, various procedures have been described, and no agreement has yet been reached as to which of these is to be considered the best. There is no doubt that modifications are desirable to suit particular requirements. Thus, many operators direct that the drug be dissolved in cerebro-spinal fluid or else in a saline solution having the same specific gravity and the same osmotic tension as the blood-serum. Others consider that the anæsthetic solution should be considerably denser or more viscous than the cerebro-spinal fluid, and for this purpose recommend the addition of glucose or of gum-acacia to the solution. These thicker solutions tend to remain at the spot at which they are injected, while solutions in cerebro-spinal fluid or in normal saline tend to spread up and down the spinal canal, and thus have a more widespread anæsthetic effect. It is usual to withdraw a few c.cm. of cerebro-spinal fluid from the spinal canal before injecting the anæsthetic fluid. There are two reasons for this—first, the surgeon is assured that he has actually introduced his needle into the spinal canal, and secondly he is certain to avoid increasing unduly the cerebro-spinal pressure when he introduces the anæsthetising fluid.

On introducing the fluid into a particular part of the spinal column, anæsthesia is produced of all parts of the body deriving their nerve supply from this part of the spinal cord, and all parts below. If the fluid be allowed to ascend the spinal canal (*e.g.* by raising the hips) the anæsthesia rises higher and higher as the anæsthetic fluid reaches the trunks of the nerves arising from the higher parts of the spinal cord. If the patient be placed on one side while the injection is being performed, the anæsthetic fluid can be made to enter one lateral half of the spinal canal, and in this way it is possible to limit the anæsthesia to one lateral half of the body.

The anæsthetic fluid can be allowed to ascend almost to the top of the thoracic spine without fear of untoward consequences. When it reaches the base of the neck, however, the phrenic nerve, concerned with the movements of respiration, becomes involved, and it was deemed impracticable to produce anæsthesia of the head and neck by the spinal method. Prof. Jonnesco, however, has shown that the addition of strychnine to the anæsthetic solution produces so powerful a stimulant effect upon the respiratory centre in the brain that it is possible to introduce an anæsthetic fluid into the upper part of the thoracic spine, and to allow the fluid to ascend the spinal canal in the neck so as to enable operations to be performed upon the neck and throat. But it is as yet too early to say whether this method may be considered a safe one.

Of the three drugs which are now chiefly used for the production of spinal anæsthesia, stovaine is found to produce the most deleterious effect upon the kidneys, acute nephritis having followed its injection in quite a number of cases. Novocaine and tropacocaine are less injurious in this way, while they are equally efficacious as anæsthetics. It thus appears likely that they will supplant stovaine in the near future, and, in fact, tropacocaine in a one per cent. solution is already being largely used for the purpose in this country, the usual dose injected being about $1\frac{1}{4}$ grain.

No doubt further experience will lead to modifications in the present method of performing spinal anæsthesia which will result in its widespread use, as there are a great many cases in which a local anæsthetic is far more advantageous to both patient and surgeon than a general anæsthetic.

A. C. J.

THE CAUSES OF THE GERMINATIVE PROCESSES OF SEEDS.

One of the most remarkable phenomena of vegetable life is the occurrence in its cycle of a resting period of varying duration, a period during which the vital functions seem entirely suspended or dormant, and the condition of the organism is hardly distinguishable from death. This stage is most common in connection with the reproductive processes, and can be seen to belong to the constitution of both spores and seeds. The more highly differentiated the structure which shows it, the more prolonged, apparently, can be this resting period, but sooner or later it gives place to the resumption of growth and vital activities.

The interpretation of the occurrence of this phase is rather a matter of inference than proof; probably it was originally concerned in the protection of the reproductive structure from adverse conditions of the environment, for not only is the life rendered dormant, but the resting organ is for the most part protected by modification of its tegumentary covering. In this condition it is able also to bear the severance of its organic connection with its parent, and to subserve the purposes of dispersal. It may, indeed, have arisen with special reference to the latter process alone.

The resumption of the growth and development of the reproductive body after the period of rest may be explained in a similar manner by the reversal of the adverse conditions, these being for the most part secured when its dispersal has been effected.

These superficial considerations are found, however, on reflection, to have others underlying them. Is the resting period of any advantage to the living substance of the reproductive structure, whether spore or seed? Does the cessation of the vital activity afford it any increased power of growth or vigour of constitution? Is it only a condition induced by circumstances, or does it speak of a rhythmic tendency inherent in the plant?

More interesting still—Is the resumption of life which we call germination an evidence of the attainment of such increased vigour, or is it merely the resumption of ordinary chemical change when inhibiting conditions are removed? In the latter case, is the living substance concerned in setting up such chemical changes, or do these arise without such initiation?

If we study the germinative changes we find them associated universally with the existence and activity of enzymes. The resting germ, whether the structure be seed or spore, is surrounded by food material deposited for its ultimate nutrition, but needing enzymic action to render it suitable for actual assimilation. The number of such enzymes known to physiologists has increased most remarkably during the last decade, and though they have been found to be most plentiful in seeds, the study of the spore has shown that it is similarly equipped, though from its unicellular character the distribution of the enzymes is much simpler. At a certain moment the germ starts into life, simultaneously the enzymes are found at work, and nutritive pabulum is presented to it in assimilable form. Which is cause and which effect? Does the living substance, awaking from a sleep, start the enzymic activity, or do the enzymes originate the change? Is the activity of the living substance itself due to enzyme action? In other words, is life a question of the existence and activity of enzymes?

These subjects can be studied more advantageously in a seed than in a spore on account of the physiological as well as anatomical differentiation which it presents. It is easy to distinguish the germ which, after resumption of growth, becomes the new plant, and to separate it from the stores of food which are laid up for its nutrition, and which will be the sphere of activity of the digestive enzymes. These stores may be within it or lying around it, but they in any case are well away from its actual growing points. In such a seed, then, we can distinguish the germ, or embryo, the new plant, and the remains of the parent which has given it origin, this being sometimes large, sometimes small, in proportion to the former.

At the outset we may ask, what is the actual condition of these two parts? How far can we find evidence of life in either during the period that elapses between the severance from the parent plant and the resumption of growth and activity after the resting stage? If we study the phenomena of life in the seed as a whole, we are led to apply to it the test of the existence and maintenance of respiration, this being the inseparable accompaniment of metabolic change and hence a constant feature of life in the various conditions with which we are acquainted. If we rely on either the absorption of oxygen or the exhalation of carbon dioxide, however, we shall be obliged to deny the presence of life in the seed at all. Many and careful examinations have been made of the respiratory processes in seeds of many descriptions. Perhaps the most exhaustive of them were those of Romanes in 1893. Seeds of various plants were kept in glass tubes which had been exhausted so completely that they contained only one-millionth of an atmosphere, and were left for upwards of a year. This treatment did not hinder their subsequent germination. Some of them were afterwards immersed in various inert gases, such as hydrogen and nitrogen, others placed in carbon monoxide, sulphuretted hydrogen, vapours of ether and chloroform, and kept thus for twelve months, still without any deleterious effects. It seems hard to suppose them living in the usual acceptation of the term. In 1892 Jodin imprisoned some seeds in ordinary air in hermetically sealed flasks; he kept them so for four years, and examination of the air at the conclusion of this term showed its composition absolutely unchanged, no exhalation of carbon dioxide having taken place. Respiration, as ordinarily understood, thus seems to be quite in abeyance.

The suspension, if not disappearance, of life during this resting period is emphasised by the behaviour of the seeds under exposure to extremes of temperature. Observations made by Wartmann so long ago as 1860 showed that germination was not prevented by preliminary exposure of the seeds to temperatures ranging from −40° to −78° C. This does not seem, however, to prove the point, for the normal temperature of agricultural land in Siberia in winter is almost as low, often reaching −60° C. Experiments were made by de Candolle and Pictet in 1879 which carried the range of temperature a little further, but the most drastic treatment was rendered possible by the liquefaction of air. Experiments with the aid of this powerful reagent have been made in France by Pictet, and in England by Brown and Escombe and by Sir W. Thiselton-Dyer, with the result that such extreme cold had very little effect in inhibiting the power of subsequent germination.

At the other end of the thermometric scale strange results have been found, many seeds having been proved capable of germinating after being exposed for a short time to temperatures higher than the boiling point of water. So long ago as 1877, Just heated seeds of a species of Trifolium to 120° C. without injuring their power of development. Some years later a more extended series of experiments was carried out by Dixon on seeds selected from several natural orders, all of which withstood, without injury, a temperature of about 105° C. prolonged for several hours. Their vitality and power of development were, however, much more easily affected by heat than by cold.

This resistance to great extremes of temperature has been found to be correlated in a considerable degree with the state of desiccation which was characteristic of the seeds. Hence is lent some support to the view of the dependence of germination on enzymic action, for the latter can only be exercised in the presence of water. Some experiments carried out by Acton in 1893 seem to show that even the small amount of water in the wheat grain enables a certain amount of digestive change to take place in both the proteins and the carbohydrates of the grain. In the absence of all moisture the enzymes remain quiescent.

As it is generally accepted that chemical action cannot take place at temperatures so low as those specified, and as chemical change or metabolic activity is an inevitable accompaniment of life as defined by Herbert Spencer, the idea that germination is dependent upon the continued and permanent life of the protoplasm in the resting seed, there have been many efforts made to explain these anomalous manifestations. C. de Candolle concluded that after a certain time the protoplasm of the ripe seed passes into a state of complete inertness, in which it is incapable of either respiration or assimilation, and that while in this condition it can support, without detriment to its subsequent revival, rapid and considerable lowering of temperature. Indeed, the access of cold to a seed seems to be only injurious as it can bring about the freezing of the water remaining in it, with the subsequent thawing as the temperature rises again. This freezing once brought about, further and more intense cold has no effect. Brown and Escombe endorsed de Candolle's idea, suggesting that protoplasm may exist in two conditions, the *static* and the *kinetic* in the former becoming so stable as to be absolutely inert, devoid of any trace of metabolic activity, and yet conserving the potentiality of life.

It is extremely difficult to decide which of the two theories provides the most satisfactory explanation of the observed phenomena. The conditions which mark the commencement of germination help us, however, to come to a conclusion, though difficulties are met with in either hypothesis. For germination to occur, moisture must be absorbed by the seed; absorption of oxygen and exhalation of carbon dioxide speedily follow, enzymic action supervenes, and the digestive changes in the reserve food materials can be readily traced. But what is the first result of the absorption of water is not so clear; is it the resumption of the kinetic condition by the protoplasm, the life of which in all other parts can be seen to be dependent on water, or is it the setting up of the activity of the enzymes, which enables metabolic, and possibly respiratory, changes to take place, such chemical action stimulating the latent life to manifestation?

Certain observations tend to show that the activity commences with changes in the embryo or germ. Van Tieghem, many years ago, endeavoured to excite into activity the endosperm of the castor-oil bean after removing from it every particle of the embryo. In most cases he failed, but in some he claimed to have been successful. The writer, many years afterwards, repeated his experiments, and found that the endosperm could only be quickened when a small portion of the germ was left in contact with it. The changes in this case originated in the embryo. Further observations showed that the earliest sign of germination in the latter is a change in certain cells of its epidermis, which take on the appearances that usually indicate the conversion of a zymogen into an enzyme. The germ appears to start the change by the secretion of an enzyme. It seems justifiable to associate this secretion with the re-assumption of life by the embryo, because, though many enzymes occur in the seed outside the latter, they do not initiate their changes until later. In this particular seed, vital activity is subsequently soon manifested in the tissue of the endosperm, which becomes the scene of very active chemical change, its residual protoplasm growing and secreting certain constituents, particularly sugars, which the resting cells do not contain.

Brown and Morris showed that a somewhat similar procedure can be observed in the barley grain. The first visible changes are the secretion of enzymes by the scutellum of the germ. The germination once started, other enzymes make their appearance in the endosperm, some arising especially from the aleurone layer underlying the testa.

A scrutiny of the results of Dixon's experiments on heating the resting seeds points also to the protoplasm as the initiator of the changes. Exposure of his seeds to 105° C. must have destroyed any preformed enzymes unless the cells were absolutely devoid of water, a condition hardly likely to be reached. The germinative power fell gradually, or nearly regularly, as the heating was raised to this point, but much remained. When, however, a very slightly higher temperature was reached, about 107° C., the seeds lost it with great suddenness and very irregularly. The injury inflicted by the last two degrees was very different from that which was sustained as the temperature gradually rose to 105° C., and was hardly explicable on the theory of enzyme destruction. It did not, at any rate, correspond to the progress of their destruction in the laboratory.

Some experiments recently carried out by Miss White in Prof. Ewart's laboratory at Melbourne bear upon this aspect of the problem. She endeavoured to accelerate the germinative processes in seeds which had but little power of germination by supplying them with additional quantities of enzymes dissolved in the water with which they were kept moist, the coats of the seeds being perforated here and there to allow absorption to take place. Though she examined many in various conditions, the result was always negative. It proved impossible to accelerate germination by supplying additional quantities of enzyme.

Experiments made by supplying resting seeds with reagents such as dilute organic acids, which stimulate their secretion of enzymes, also have been found to be without result.

The idea that enzymes initiate and maintain the process of germination appears, therefore, to be erroneous, and the older view of the sufficiency of the idioplasm of the cells still holds the field, in spite of the difficulties that have been raised by the experiments with temperature. The theory of static and kinetic states of protoplasm explains little or nothing; it is really scarcely more than a statement of the problem in new terms.

J. Reynolds Green.

DR. W. J. RUSSELL, F.R.S.

William James Russell was born in May, 1830, at Gloucester, where his father was a banker. He was educated at private schools—Dr. Wreford's at Bristol, and afterwards at Mr. Bache's at Birmingham. In passing, it may be noted that this was before the educational revival that produced and was furthered by the Public Schools Commission of 1859, and that in those days there were very many private schools where scholarship was carried to quite as high a level, and when the conditions of out-of-school life were in some respects much better than in most of the public schools of the time.

After leaving school in 1847, Russell entered University College, London, where he studied chemistry under Thomas Graham and Williamson. In 1851 he was appointed the first demonstrator of chemistry under Frankland in the then newly-founded Owens College, and helped to plan and superintend the building of the first chemical laboratory of the college. This laboratory, built on what had been the garden attached to the original college building (Mr. Cobden's old house in Quay Street), was the cradle of the great Manchester School of Chemistry, which has become as famous in its way as the Manchester School of Politics. After two years at Owens College, Russell went to Heidelberg, where he worked under Bunsen from the autumn of 1853 to the end of the session 1854–5. During his stay at Heidelberg, he graduated as Ph.D. After his return to England, he lectured at the Midland Institute, Birmingham, and near the end of 1857 came again to London to act as assistant to Williamson, his former teacher, at University College. He was associated with Williamson for several years, a considerable part of the time being occupied with working out and bringing to a convenient practical form a method of gas-analysis whereby the corrections involved in taking account of variation of pressure and temperature were in great measure eliminated. The results of this investigation were embodied in several papers published in the Journal of the Chemical Society and elsewhere, and the form of apparatus finally arrived at was the forerunner of the most improved modern types of gas-analysis apparatus and instruments for the application of the measurements of gases to quantitative analysis.

From 1868 to 1870, Dr. Russell was lecturer on chemistry in the Medical School of St. Mary's Hospital. In the latter year he was appointed to a similar office at St. Bartholomew's and retained this appointment until 1897. After his retirement, he continued his experimental work, and until very recently was actively occupied at the Davy-Faraday Laboratory. He died at his house at Ringwood, after a very short illness, on the twelfth of the present month (November, 1909).

At the time of his death, Dr. Russell was one of the oldest Fellows of the Chemical Society, having been elected in 1851. He served on the council from 1863 to 1867, and from 1870 onwards his official connection with the society was unbroken: he was a member of the council from 1870 to 1872; vice-president, 1872 to 1873; secretary, 1873 to 1875; treasurer, 1875 to 1889; president, 1889 to 1891, and since the last date a permanent vice-president. The society, which was only ten years old when Russell joined it, celebrated the jubilee of its foundation in 1891, during his term of office as president. It naturally devolved upon him to take the leading part in the proceedings, and all who were present must have been struck by the admirable manner in which he acquitted himself. He had to make many speeches, long or short, and they were always simple and appropriate. Without wasting words, or any apparent striving after effect, he managed every time to say exactly what wanted saying.

He was elected a Fellow of the Royal Society in 1872; he served twice on the council, and was a vice-president from 1897 to 1899. He was an original member of the Institute of Chemistry, founded in 1877, was president from 1894 to 1897, and served various other offices between 1878 and 1904.

Dr. Russell's connection with Bedford College (London) extended over many years of his life, and was of very great value to the college. It began with his being appointed professor of natural philosophy in 1860. He retained this office until 1870, and opened in 1860 the first laboratory accessible to women-students for practical work at science. He was a member of the council of the college from 1878 to 1903, being chairman from 1887, and also chairman of the college board of education from 1895. During Dr. Russell's chairmanship, the college was twice enlarged, and at the end of his term of office the necessity for still further extension had become so pressing that it was decided to start a fund to provide an entirely new building. He was an active supporter of this movement, and contributed liberally to the fund.

Dr. Russell's contributions to the methods of gas-analysis have been mentioned already. Among other investigations, we may refer to those relating to the atomic weights of nickel and cobalt (1863 and 1869), which were important in consequence of the way in which results obtained by very different methods were employed to check each other; a series of papers in conjunction with Dr. Samuel West, F.R.S., on a new method of estimating urea, which gave rise to a valuable clinical method; papers (conjointly with Mr. Lapraik) on absorption spectra, and notably one on the absorption bands in the visible spectra of colourless liquids, which was the pioneer paper in a branch of inquiry that has been most ably followed up by Prof. Noel Hartley, F.R.S., Mr. E. C. C. Baly, F.R.S., and others; a remarkable series of papers on the action of metals, resins, wood and other materials on a photographic plate in the dark. Some of the results of this investigation were given to the Royal Society as the Bakerian lecture for 1898. By well-directed and persevering experiments, the effects observed were traced to the generation of peroxide of hydrogen. In another set of experiments on the figures formed by the deposition of dust, Dr. Russell demonstrated the curiously definite course of the convection currents of air that rise from a heated solid body.

A report made to the Science and Art Department, in conjunction with Sir William Abney, on the action of light on water-colours was published as a Blue Book in 1888. It involved a very careful investigation of the subject, and was highly appreciated by artists. A committee consisting of the president and other prominent members of the Royal Academy in reporting on it said that they "unanimously desired to record their sense of the very great value and of the thoroughness and ability with which so laborious an inquiry had been conducted."

In manner, Russell was quiet and entirely free from anything approaching self-advertisement, but he was genial and hearty with his friends, and was gifted with a sympathetic laugh that it was always refreshing to hear. As some indication, both qualitative and quantitative, of the estimate formed of him by his fellows, it may not be out of place to mention that, as a young man, he was the first secretary, treasurer, and keeper of the archives of the B Club—originally a society of young chemists which grew out of Section B of the British Association, first took definite shape at the Oxford meeting in 1860, and kept itself alive between the meetings of the Association by consuming monthly beef-steak puddings at the "Cheshire Cheese"—and that, in later life, he was elected to serve on the committee of the Athenæum Club. His death will be felt as a sore personal loss by very many. He was liked by all who knew him, and by all who knew him intimately he was held in affectionate esteem.

Dr. Russell married, in 1862, Fanny, daughter of the late A. Follett Osler, F.R.S., of Edgbaston. He leaves one son, and a daughter married to Dr. Alexander Scott, F.R.S. G. C. F.

NOTES.

THE *Standard* for November 22 contains a full list of the House of Lords, classified according to their qualifications. It is disappointing to find only two names—those of Baron Rayleigh and Baron Lister—under the heading "Scientists," while "Educationists" are only represented by Baron Ashcombe, member of council of Selwyn College; Baron Killanin, member of Senate of Royal University of Ireland; and the Earl of Stamford, formerly professor of classics and philosophy at Codrington College, Barbados. There are thirty-five railway directors, thirty-five bankers, and thirty-nine so-called "captains of industry" on the list, and a column and a half under "Military and Naval Services."

AT the meeting of the Royal Society of Edinburgh on Monday, November 22, the Makdougall-Brisbane prize for the biennial period 1906–8 was presented to Mr. D. T. Gwynne-Vaughan for his papers (1) "On the Fossil Osmundaceæ," and (2) "On the Origin of the Adaxially Curved Leaf-trace in the Filicales"; and the Gunning Victoria Jubilee prize for the third quadrennial period 1904–8 was presented to Prof. G. Chrystal, for "A Series of Papers on 'Seiches,' including 'The Hydrodynamical Theory and Experimental Investigations of the Seiche Phenomena of Certain Scottish Lakes.'"

THE Livingstone gold medal of the Royal Scottish Geographical Society has been presented to Sir Ernest Shackleton, in recognition of his work in the Antarctic.

PROF. W. BATESON, F.R.S., professor of biology in the University of Cambridge, has been appointed director of the John Innes Horticultural Institution at Merton, Surrey.

LIEUT.-COLONEL D. PRAIN, F.R.S., director of the Royal Botanic Gardens, Kew, and Prof. F. O. Bower, F.R.S., regius professor of botany in the University of Glasgow, have been elected corresponding members of the Munich Academy of Sciences.

THE council of the Royal Meteorological Society has awarded the Symons gold medal to Dr. W. N. Shaw, F.R.S., in recognition of the valuable work which he has done in connection with meteorological science. The medal will be presented at the annual general meeting of the society on January 20, 1910.

THE King has approved of the Polar medal, with a clasp, inscribed "Antarctic, 1907–1909," being granted to members of the Shackleton Antarctic Expedition, 1907–9, the clasp alone being awarded to those who already possess the Polar medal; the medal and clasp to be in silver for the shore party and in bronze for those who remained with the ship.

DR. T. G. LONGSTAFF writes to the *Times* from Kashmir to correct a statement made in the issue of October 1, and referred to in NATURE of October 7, to the effect that he had found that the source of the Tarim River of Kashgaria is in the Siachen Glacier of Nubra. He says that what he has just been able to prove is that the Siachen Glacier of Nubra is merely the lower portion of the glacier found beyond the Saltoro Pass by Dr. A. Neve, Lieut. Slingsby, and himself in June last, and temporarily designated the Terim Glacier.

A MEETING of subscribers, both ladies and gentlemen, will be held at 5 p.m. on Tuesday, November 30, at the rooms of the Society of Antiquaries, Burlington House, London, to determine in what manner the fund which has been raised as a memorial to the late Prof. Arthur Gamgee should be applied to serve the object for which it was collected. Subscriptions may be sent to Prof. Arthur Schuster, Victoria Park, Manchester; Dr. A. D. Waller, Physiological Laboratory, University of London, S.W.; or Dr. G. A. Buckmaster, University College, London, W.C.

THE annual meeting of the Iron and Steel Institute will be held on Wednesday and Thursday, May 4 and 5, 1910. The proceedings will begin by the induction of the new president, the Duke of Devonshire, into the presidential chair by the retiring president, Sir Hugh Bell, Bart. Under the new bye-laws the council now has the power to elect honorary vice-presidents from among distinguished members of the institute who, by reason of their residence out of Great Britain, are unable to take a very active part in the affairs of the institute. The council has accordingly elected the following to the office of honorary vice-president:—Mr. John Fritz, United States; Mr. William Kestranek, Austria; Baron Fernand d'Huart, France; Mr. F. W. Lürmann, Germany; and Mr. E. J. Ljungberg, Sweden.

THE summary of the weather for the week ending November 20, issued by the Meteorological Office, shows that the conditions for the period were generally dry and fine over the entire kingdom. The temperature was everywhere below the average, the deficiency amounting to 11·6° in the west and east of Scotland, 9·6° in the north of Scotland, and 8·7° in the north-west of England. The minima, which occurred in most places about the middle of the week, were extremely low in Ireland and Scotland, making a record for November in parts. At Balmoral the sheltered thermometer on November 16 fell to 3°. The radiation temperature on the grass fell to −5° at Crathes, in the east of Scotland, to zero at Balmoral, and to 8° at Markree Castle. At Greenwich frost occurred only on one night in the shade during the period, but in the open, on the grass, there was a frost each night. The rainfall was less than the average in all parts of the kingdom, and in many parts the week was rainless.

ON November 18 and succeeding days the famous volcanic mountain Pico de Teyde, on the north-west of the island of Teneriffe, was in eruption from four craters lying from east to west. The two inside craters are reported to be active alternately, emitting liquid lava only. Owing to the configuration of the ground it is not possible to dam the lava streams or to divert them into channels where they would do less damage. On November 21 the lava stream is said to have travelled $3\frac{3}{4}$ miles since the beginning of the eruption. An official telegram from Teneriffe on November 23 reports:—"The chief crater continues to throw out large quantities of incandescent matter to a height of above 2000 feet. The flow of lava is increasing in volume. The stream running down the Santiago Valley has divided into two, each 12 feet deep and of constantly increasing breadth. The stream flowing in the direction of the Tauranno is advancing more rapidly, and will shortly be swollen by its junction with another stream which has branched off from the main flow. The lowest point of the stream flowing towards Tanque has made no progress since yesterday, and there appears for the moment to be no fear of its resuming its advance, as the crater by which it is fed is becoming less active. On the other hand, the activity of the craters from which the lava flows towards the Santiago Valley is increasing."

THE board of anthropological studies of the University of Cambridge recently re-appointed Mr. A. R. Brown, of Trinity College, to the Anthony Wilkin studentship. This studentship was founded in 1905 in memory of Anthony Wilkin, of King's College, Cambridge, by his parents, for the encouragement of research in ethnology and archæology. Mr. Brown was elected to the first studentship in the same year, having intimated his desire of studying the social structure and religion of the Andaman Islanders. He returned about eighteen months ago, and since that time has been occupied in writing up his field notes. It is expected that his monograph on the Andaman Islanders will be published next spring. Dr. A. C. Haddon informs us that Mr. Brown's next expedition will be to Western Australia. Extremely little is known about the ethnology of the whole western portion of Australia, and as Westralia is being rapidly developed it is essential that the natives should be thoroughly studied before it is too late. From what little is known, it is evident that the social system of the natives is not uniform, and it is to be hoped that the transition from one form of social organisation to another may be discovered. Mr. Brown proposes to make a general survey of the social and religious conditions of as many tribes as possible, and to make a minute study of one or two of them. If funds permit, he will traverse the continent so as to link up his observations with those of other ethnologists, and at the same time he may be able to clear up some disputed points in the results obtained by previous workers in the field.

THE eighth exhibition of motor-cars arranged by the ociety of Motor Manufacturers and Traders was held at Olympia during last week. The principal point regarding the many cars exhibited is the almost entire absence of chain drive; in almost every case the live axle is adopted.

In several cases the gear-box is secured rigidly to the engine, thus securing correct alignment should warping of the frame of the car occur. Many of the cars are fitted with front-wheel brakes; the Allen-Liversidge arrangement consists of band brakes on drums secured to the steering wheels on the steering bracket sides, and operated by means of cables passing over pulleys mounted on the steering pivots. The risk of side-slip is much reduced by having the brakes on the front wheels. Most of the cars are petrol driven, steam and electric cars being represented by a few examples only. Among the many accessories shown, the Bowden speed indicator is worthy of notice. In this indicator five steel balls move in radial slots in a rotating disc, and as the speed increases they move outwards and also upwards, being guided by a cup-shaped disc, on which they rest. Another disc, resting on the top of the balls, thus has an upward movement communicated to it, and actuates a pointer through a rack and pinion gearing. The indicator has great sensitiveness and freedom from lag, and, owing to the absence of revolving links, springs, &c., should be applicable to the indicating of much higher speeds of rotation than most instruments at present available are capable of dealing with.

THE subject of the prehistoric antiquities of Scandinavia continues to receive attention in *Naturen*, Prof. A. W. Brøgger contributing an article to the November number in which objects of this nature are figured. Attention is directed to the light thrown on Scandinavian antiquities by those of other countries. Among the figures are copies of two excellent prehistoric representations of reindeer and another of a bear.

THE progress of the plan for marking young birds in this country, initiated by the editors of *Witherby's British Birds*, forms the subject of a note in the November issue of that serial. Out of 4750 rings issued, only 2200 are reported as having been used, this comparatively small proportion being largely due to the late date on which the distribution was made. Taking this fact into consideration, the originators of the scheme consider that the number of birds ringed is satisfactory, and lend to expectation of interesting results, which it is hoped will be exceeded next year, when the rings will be issued sooner.

IN the report of the Museums of the Brooklyn Institute of Arts and Sciences for 1908, Dr. F. A. Lucas is enabled to record a marked improvement in the exhibition series owing to the completion of the east wing of the main building. Great stress is laid on the importance of displaying the exhibits in a picturesque and attractive manner, which can be done, if proper care be exercised, without in any way impairing their scientific interest. It is intended to add pictures of invertebrate life above the cases devoted to the lower organisms, and a beginning has been made in the shape of a sketch of a coral-reef. Other paintings are to be devoted to the beach of a coral-island, the purple jelly-fish, and the Portuguese man-of-war. Attention is directed to a recently mounted group of hoatzias, of which a photograph forms the frontispiece to the report.

IN the September number of the Biological Bulletin of the Woods Hole Laboratory Prof. Raymond Pearl and Miss M. R. Curtis give an account of a partially hermaphrodite Plymouth rock fowl hatched at the Maine Agricultural Station in the spring of 1907, and killed in August, 1908. As regards colour and bodily shape, this bird resembled a normal female of the breed, but the head and neck, especially in respect of the development of the comb and wattle, recalled a young cock. In general behaviour it resembled a hen rather than a cock, although it occasionally made unsuccessful attempts to crow. Internally a large lobulated gland on the left side occupied the position of the normal ovary, while there was also a complete and functional oviduct; but on the opposite side occurred a small organ representing a testicle, with a normal efferent duct leading to the cloaca. The sexual glands of each type were in a degenerate condition, and apparently incapable of developing their proper sexual elements. The authors of the paper cite another instance of incomplete hermaphroditism in domesticated fowls, as well as one in which the hermaphroditic character was fully developed.

AFTER describing certain new forms of the remarkable fossils typified by those named Edestus, Prof. O. P. Hay, in No. 1699 (vol. xxxvii., pp. 43–61) of the Proceedings of the U.S. National Museum, discusses the nature of these spiral serrated structures. It has been generally considered that these structures represent the spines found on the tails of rays like Trygon. Dr. Hay is, however, of opinion that they should be associated with the dorsal fin. Their structure may be most easily explained "by supposing that some ancient elasmobranchs developed in front of a median dorsal fin, or in place of it, not a single spine, but a succession of them. The new compressed spine, serrated in front and behind, arose in front of the older ones. Nevertheless, the root of the new spine became directed backward beneath and on each side of the preceding one, so as partly to embrace it. At first probably the older spines were shed, but in time they began to cohere and thus form a compound spine. In Edestus this was straight or slightly bent. All, or nearly all, of it, except the serrated teeth, was buried in the flesh. As more and more elements were added, the organ became more curved, and finally in some species formed a spiral, which was directed backward and the last turn of the shaft of which was elevated enough to keep the teeth from cutting into the skin. Such a weapon could be brought into action if only its possessor had dived under its victim and brought the spine across its abdomen, thus disembowelling it. . . . It is in this way that Gasterosteus attacks its victims."

THE abnormality known as vivipary, in which young shoots are formed in place of flowers, is described by Mr. G. N. Collins in Contributions from the United States National Herbarium (vol. xii., part x.) for some varieties of the maize plant imported from Mexico and Central America into the States. The shoots arise in the axil of a glume in the position of staminate spikelets, and roots are developed at the base; plantlets placed in the ground made some growth, but failed to mature. The phenomenon is attributed to the excessive vegetative growth shown by tropical varieties of corn when transported to a temperate region. The title-page and index to the volume have now been issued.

AN account of the pear thrips, *Euthrips pyri*, prepared by Mr. D. Moulton, and published by the United States Department of Agriculture as Bulletin No. 68, part i., of the Bureau of Entomology, is the outcome of the writer's investigation of a pest which flourished for two years in the San Francisco region. There is an instructive comparison of the light ravages on the early flowering almond, with the destruction caused on the later blooming prunes, cherries, and pears, that open their flower buds just as the thrips reach their active feeding stage. During the second larval stage the insect enters the ground, where it pupates, and finally emerges as an adult thrip in the spring.

The underground hibernation provides an opportunity for killing the larvæ by ploughing; also the insect has various natural enemies in the shape of spiders, mites, and an unidentified fungus.

An article on *Cornus macrophylla* and other species of the genus is communicated by Mr. B. Hemsley to the *Kew Bulletin* (No. 8). He points out that two evidently different species are passing under the name of *Cornus macrophylla*, the one with opposite leaves, correctly named, the other with alternate leaves, for which he proposes the name *Cornus controversa*. He also describes three new Asiatic species, and discusses the nomenclature of some recent determinations. A short note that deserves mention, partly with the view of eliciting more information, refers to the reported use of plant extracts in Siam as remedies for snake-bite. The evidence depends upon the testimony of natives, who supplied specimens of the plants, which have been identified as *Barleria lupulina* and *Justicia Gendarussa*, both members of the Acanthaceæ. The extract gave characteristic alkaloidal reactions, and contained a quantity of calcium and potassium; these properties are possessed by several plants of this family.

The Journal, formerly called the Bulletin, of the Tokyo College of Agriculture, recently received, contains several papers on the availability of various phosphatic manures and on the influence on crop-yields of different ratios of lime to magnesia in the soil, a subject to which considerable attention has been paid in Japan. One of the most striking results obtained was that the manurial value of lecithin is about equal to that of sodium phosphate, whilst phytin is nearly equivalent to ferric or aluminium phosphate; nuclein possesses very little manurial value. The experiments were made in soil culture, but similar results are said to be obtained in sand culture also. Of these three compounds, phytin occurs most commonly in plants, and the other two in much smaller quantities. The experiments were devised to throw light on the changes taking place when vegetable matter is dug into the ground, and to explain the beneficial effect on the succeeding crop.

The Department of Agriculture, Madras, has issued a bulletin describing improvements in paddy cultivation on a farm under the management of the Court of Wards. The best and cheapest fertiliser was found to be farmyard manure, but a sufficient quantity is not available, and recourse is therefore had to other fertilising materials. Certain plant residues, leaves, poonacs, &c., may be used, but they are too expensive if they have to be brought from any distance. The most successful plan has been to cultivate leguminous crops on the wet land itself during the dry season and in the season in which there are only occasional showers of rain, then to pull up and trample in the crop after ploughing the land.

The Bulletin of Agricultural Information of the Department of Agriculture, Trinidad, contains numerous notes on cacao. The maintenance of the fertility of the soil is likely to become an important problem before long; at present it is not unusual for a few acres of land to be rented, and when they cease to be remunerative for the tenant to go elsewhere. The land is then abandoned for a few years, covers itself with bush, which is subsequently cleared and burnt, cropped for a short time, and again abandoned. Another source of loss is found in the heavy tropical rain, which washes away finer soil particles as well as some of the plant food. This and other local problems are dealt with at some length.

The geological age of *Homo heidelbergensis* is discussed by Dr. Emil Werth in *Globus* (xcvi., p. 229); Schoetensack allocates this find to the earliest Diluvium (Nature, July 29, p. 132), but Werth, arguing from the associated remains, attributes it to the last but one inter-Glacial age, the Mindel-Riss-Interglazial of Penck. To this period belong the Mauer sand and the high terrace of the Rhine, since both lie below the later loess of the last (Würm) Ice age and the older loess of the last but one (Riss) Ice age. The Gravel of Süssenborn belongs to the same period, as it yields *Rhinoceros etruscus*, *Elephas trogontherii* (like the high terrace of the Rhine and the Norfolk bed), *Elephas meridionalis* (as found in Mindel-Riss-Interglazial stratum on the south side of the Alps), and also a horse allied to *Equus stenonis* of the Mauer sand. At St. Acheul, as at Mauer, there are three terraces, the middle one corresponding to the middle one on the Neckar, as it is covered by both sorts of loess. In the lower sand and gravel of this terrace of St. Acheul is human handiwork of characteristic Chellian form, which, according to Penck, belongs to the Mindel-Riss-Interglazial time. *Homo heidelbergensis* then lived exactly in the middle of the Ice-age period; the end of the Tertiary age was as remotely behind him as the old Palæolithic Chellian culture of his times is behind us. He does not represent the old diluvial Eolithic age, still less is he a type of Tertiary man. Werth considers that this conclusion modifies the arguments which have been based upon the character of the jaw, and he disputes Schoetensack's view that it is of a type prior to that of the anthropoids. He attributes the powerful development of the jaw to have arisen in response to an earlier stronger dentition, and accounts for the deterioration of the teeth by the discovery of fire to soften the food and the employment of stone implements, which did the work for which teeth were previously used.

The first section of an important paper by Prof. C. F. Marvin, on methods and apparatus for the observation and study of evaporation, appears in the *U.S. Monthly Weather Review* for April. The author points out that while, instrumentally, it is very easy to measure evaporation under certain conditions, it is very difficult to correlate the results obtained by different observers, not that the contributions are necessarily inaccurate, but because they are solutions of a complex problem not yet fully understood. In this section Prof. Marvin deals with the customary methods and their failings, and with the various equations, which he separates into two classes—(1) those developed from mathematical equations representing the phenomena of pure diffusion, and (2) partly rational and partly empirical equations intended to express the relation between evaporation and the meteorological conditions by which it is influenced. Section ii., which will be published subsequently, will deal with apparatus; the author will then describe a special instrument, devised by himself, which records simultaneously on the same sheet the wind, evaporation, and rainfall (if the evaporation pan is not sheltered from precipitation).

In the *Revue générale des Sciences* of October 30, M. L. Teisserenc de Bort gives an interesting account of an investigation of the meteorology of the tropics, based chiefly on observations with kites and registering balloons in the Atlantic between 35° N. and 8° S., and between the coast of Europe and 47° W. longitude. The author goes at some length into the history of the subject and the methods of launching and recovering the balloons, but we can here only briefly refer to the general results obtained. The N.E. trade wind was found to extend, on an average, to about a height of 1000 metres, then a zone was met with in which the winds came generally from N.W. These N.W. winds appeared to cease at about 10° from the point of convergence of the trade wind, which in summer is about 8° N. At a greater height the zone of winds with a southerly component, forming the anti-trade, was met with; on approaching the equator this zone was found at a lower altitude, being at about 1800 metres near Cape Verde Islands. Temperature first decreased rapidly with height; above 500–600 metres a zone with slight decrease, and extending with or without inversion up to about 2500 metres, was met with, as previously pointed out by Prof. Hergesell. In the neighbourhood of the anti-trade the temperature commenced to decrease regularly up to 14 or 15 kilometres. Above this height the so-called isothermal zone was found, the existence of which was pointed out by the author some years ago. These characteristics are analogous to those observed in temperate regions during a well-formed area of high barometrical pressure.

THE Bausch and Lomb Optical Company, 19 Thavies Inn, Holborn Circus, has published a new microscope chart for use in laboratories where instruction is given in practical microscopy. This appears to be becoming a recognised method of advertising with Continental and American microscope makers, although we are not aware that any English firm has yet issued such a chart. It is extremely well got-up, shows the mechanical and optical essentials of the instrument very well, as well as diagramatically representing the direction and path of the rays of light which pass from the illuminant and go to form the microscopic image. The chart may be obtained gratis by any college or medical institution, and it can be used with advantage wherever work is done with the microscope.

MESSRS. ERNEST LEITZ, of Wetzlar, Germany, and 9 Oxford Street, W., have issued a new edition of their catalogue of microscopes, and a separate one of microscopical accessories. It is interesting to note that Messrs. Leitz are always more nearly approaching the English type of stand in their new model microscopes; in one at least of their recent instruments the English type has been entirely adopted. They are also bringing out new achromatic condensers, and providing much more efficient arrangements for the centration of these on the microscope. Their new reflecting condenser for dark-ground illumination, which differs from any other in that it consists of spherical reflecting surfaces, is among the best to be obtained. They claim for it that not only is its correction of the highest order, but that the amount of light that actually reaches the object is greater than in any other appliance of a similar nature. In general, the character of the productions of this firm is such that workers who wish to obtain instruments for microscopy may well give attention to these new catalogues.

IN the course of his address to the Northern Architectural Association, an abstract of which appears in the *Builder* of November 13, the president, Mr. G. T. Brown, dealt with the question of architectural copyright. The law, as it stands at present, is that the client may demand, not only the whole of the drawings and specifications, but also the studies and detailed calculations, and there is nothing to prevent his making what use of them he pleases. Other buildings may even be carried out by their aid without the architect receiving any compensation for them whatever. Means are taken in other countries to protect the interests of the architectural profession, and the hope is expressed that a Government Bill will be introduced at an early date to deal with the matter.

AN interesting article on New York City bridges, by Mr. T. Kennard Thomson, appears in the *Engineering Magazine* for October. Among other bridges illustrated and described is the Williamsburg Bridge, which is claimed to be the most rigid long-span suspension bridge ever built. The main span is 1596 feet, and the total length of the bridge is 7250 feet, nearly one and a half miles. The stiffening trusses are about 40 feet deep; the four main cables are each made up of thirty-seven strands, each strand containing 208 wires, making a total of 31,784 wires in the four cables. Expansion and contraction and the effect of the live load produce a deflection at the centre of the span of 6 feet 9 inches, and yet this is a very rigid suspension bridge. The Brooklyn suspension bridge has a river span of 1595 feet, the total length being 6000 feet. Its centre rises and falls about 9 feet each way (18 feet in all), partly owing to the loading and partly to fluctuations in temperature. The extreme deflection of the new Blackwell's Island bridge is expected to be about 20 inches. This latter bridge is unique among long-span bridges in respect of the cantilever arms meeting in the centre without any intervening span.

MESSRS. CONSTABLE AND CO., LTD., have just published a cheap edition (2*s*. 6*d*. net) of Prof. H. H. Turner's "Modern Astronomy," originally issued in 1901, and reviewed in NATURE of March 21 of that year (vol. lxiii., p. 488). The book gives an admirable account of instruments, methods, and results of astronomy during the last quarter of the nineteenth century, and should now reach a wide circle of readers.

THE fifteenth volume of the new series of the "Reliquary and Illustrated Archæologist" has been published by Messrs. George Allen and Sons at the price of 12*s*. net. The volume contains the four quarterly parts issued this year, the contents of which have been referred to in these columns as the parts first appeared. It forms a handsome, well-illustrated book, which should appeal to all readers interested in early Pagan and Christian antiquities, mediæval architecture, the survivals of ancient usages, and similar subjects.

MESSRS. WITHERBY AND CO. have published a second edition of Mr. M. J. Nicoll's "Three Voyages of a Naturalist," being an account of many little known islands in three oceans visited by the *Valhalla*, R.Y.S. The original issue of the book was reviewed in NATURE for May 14, 1908 (vol. lxxviii., p. 32), when one of its numerous illustrations was reproduced. The only material alteration in the second edition is in chapter xx., where the statement has been corrected that Easter Island, when first discovered, was uninhabited.

A SECOND edition of "A Treatise on Concrete, Plain and Reinforced," by Dr. F. W. Taylor and Mr. S. E. Thompson, with chapters by various other writers, has been published by Messrs. John Wiley and Sons in New York, and by Messrs. Chapman and Hall, Ltd., in this country. The first edition was reviewed in our issue of March 15, 1906 (vol. lxxiii., p. 457). The second edition aims to cover the developments in the design and construction of reinforced concrete since 1905, and to this end more than two hundred pages of new matter have been added. The price of the new edition is five dollars.

MESSRS. BAIRD AND TATLOCK (LONDON), LTD., have sent us a copy of their latest catalogue of general apparatus. The comprehensive character of the catalogue will be gathered from the fact that it runs to 848 large pages. Sections are included in the list dealing with different types of laboratory and other benches, fume cupboards, and other fittings; the special apparatus required for physico-chemical experiments, and instruments necessary for milk, oil, paper, and water analysis, in addition to general bacteriological and chemical apparatus. The volume will make a very useful addition to the laboratory library of working books; its numerous illustrations, concise descriptions of the more complicated instruments, and orderly arrangement will prove real aids to the selection of laboratory apparatus.

The librarian of the Library of Congress, Washington, has issued two "Want Lists," each running to more than two hundred pages, one dealing with the publications of societies and the other with periodicals. In a prefatory note to each volume, librarians and secretaries of institutions receiving copies of the lists are asked to check them and to notify the Library of Congress of any duplicates at their disposal which may help to complete the files of the Washington library. We observe that certain copies of NATURE are in request; perhaps some of our readers may have duplicate copies of the following issues, now out of print, which the librarian of Congress would be glad to receive:—1899—May 4, June 15, 22, July 6 to August 10, September 14, and title and index; 1901—August 1, 16 to October 10, 24, 31, and title and index. Librarians are invited to send to the Library of Congress lists of their wants, as there is at Washington a stock of duplicates available for exchange.

OUR ASTRONOMICAL COLUMN.

Atmospheric Refraction.—The Rev. W. Hall, Chaplain Instructor, R.N., has circulated a typescript article on "Refraction in Relation to Astronomical Navigation." It is short and clearly expressed; nothing is assumed as already known, and yet the reader is taken to the furthest limits required for the writer's purpose. The article is therefore a model of what such articles should be.

For purposes of refraction, rays fall under three classes:—(1) a ray from a high star; (2) a ray from a low star; (3) a ray from the horizon finally reaching the observer's eye a few feet above sea-level, but ten miles from his horizon. The second ray is outside the scope of the article, as navigators ought not to observe low stars. The other two rays are considered in detail, and full advantage is taken of the simplifications rendered possible in one case by the altitude of the star and in the other by the thinness of the stratum of the atmosphere traversed. Proper warning is given that the state of the atmosphere at the horizon may not correspond to the barometer and thermometer readings on board ship.

The Spectrum of Halley's Comet.—Using a slitless spectroscope, attached to the Crossley telescope, Mr. W. H. Wright succeeded in photographing the spectrum of Halley's comet on October 22, about 180 days before the computed perihelion passage.

Two hours' effective exposure was given, the guiding being effected by a movable micrometer attached to the telescope. The plate shows a faint continuous spectrum extending from about λ 3750 to λ 5000, and there is no evidence of the existence of any bright lines or bands characteristic of most cometary spectra; the spectrum is too faint to determine the presence, or absence, of dark lines (Lick Observatory Bulletin, No. 167).

Seasonal Change on Mars.—Through the Kiel Centralstelle (Circular No. 115, November 18) Prof. Lowell announces that the first apparent Antarctic snowfall of the season has taken place on Mars. Two patches have appeared in latitude 65°, one in longitude 100°, the other in 190°.

Other changes and new features are announced by MM. Antoniadi, Quénisset, and J. Comas Sola, respectively, in the November number of the *Bulletin de la Société astronomique de France*. M. Antoniadi reproduces, on four plates, four drawings of the planet made during September and October, and gives several conclusions to which he has been led by his observations at this opposition. Among these we notice that he affirms the superiority of larger instruments in observations of Mars. He also finds that the grey areas are subject to great modifications of contour, although the Syrtis Major now has the same aspect as in 1864. As regards the objective existence of "canals," M. Antoniadi urges that care should be taken in the nomenclature; some of these features are undoubtedly real and persistent, others have an undulated appearance and are more or less fugitive. He concludes by suggesting that with more powerful equipment the apparent geometrical arrangements would give place to irregularities both of form and tone.

Among other observations, M. Quénisset directs attention to the unusual dimensions of the Lacus Mœris and to the apparent periodicity of a canal to the south-west of Nectar.

M. Sola describes his observations of the Lacus Solis, and believes he has seen it triple, while he suggests that the two canals, Nectar and Bathys, are really made up by alignments of small "lakes" imperfectly seen, the latter canal being much more easily seen than in many previous oppositions. Fons Juventæ, seen in 1907, has remained absolutely invisible to him during the present opposition.

The Perseid Meteors in 1909.—During July and August watch was kept, at the Lick Observatory, for the August meteors, and on nine nights 755 meteors were seen. A special watch was kept on August 10 and 11, and 220 meteors were seen. July Perseids were exceptionally scarce and faint, and the maximum of the shower occurred on August 11, the horary rate, during a continuous watch lasting from 11h. 17m to 14h. 41m., being 117. Mr. Oliver states that the radiant appeared to cover a large area, and there was difficulty in separating it from the radiants of the contemporaneous minor showers.

A Daylight Meteor.—Dr. Palisa records the telescopic appearance of a meteor on September 4 at 10.30 a.m. Whilst making a daylight observation of Castor he was looking through a 1·5-inch finder, having a field of 2°, and saw a bright object cross the field. The velocity was small, and the shape was rather square than circular; the direction was from east to west, and the object was surprisingly large, appearing at least as bright as Venus (*Astronomische Nachrichten*, No. 4367).

Spectroscopic Binaries.—In No. 3, vol. xxx., of the *Astrophysical Journal*, Dr. S. A. Mitchell publishes particulars of seven spectroscopic binaries, determined from plates taken at the Yerkes Observatory and measured at the Columbia University. The stars dealt with are β Equulei, β Trianguli, γ Lyræ, θ Virginis, o 78 Virginis, 24 o^2 Canis Majoris, and ζ Canis Majoris.

The "Annuaire" of the Bureau des Longitudes, 1910.—We have received a copy of this "Annuaire," which is too well known to require detailed description; but it should be remarked that, in accordance with the innovation of 1904, the chemical and physical data are given this year and geographical and statistical data omitted. Similarly, in the astronomical section, the tables of stellar parallaxes, double stars, proper motions, &c., are omitted, and a complete list of the elements of the minor planets is published; about 800 of these objects are now included. The "Annuaire" also contains articles on the reunion of the International Committee for the *Carte du Ciel*, and on tides.

CONFERENCE ON MALARIA IN INDIA.

A FURTHER stage in the campaign against malaria has been reached by the inauguration of a conference on malaria at Simla under Government auspices, a report of the proceedings of which appears in the *Pioneer Mail* of October 15 and 22.

The proceedings were opened with an address by the Viceroy, who, after welcoming the delegates on behalf of the Government, pointed out how grievously India has suffered from the scourge of malaria, which is probably responsible in an ordinary season for one million deaths in the year and for 100 million cases of fever that are not fatal. The prevention of malaria depended upon the extermination of the malaria-carrying mosquitoes, on the prevention of their bites, and on the prophylactic use of quinine. The extermination of the mosquito was largely a question of administration and finance and of the development of sanitation.

An address was then delivered by Colonel Leslie, I.M.S., Sanitary Commissioner with the Government of India. He said:—"It is obvious, if malaria is due solely to the bites of anopheles mosquitoes, that the extirpation of these mosquitoes will abolish malaria. The continuous use of quinine, even for a short time, is inconvenient, unpleasant to the individual, and difficult to carry out among a community. It is therefore evident that the best way to get rid of malaria is to destroy the mosquitoes. The only questions are, Can it be done? and, if it can, At what cost? It has been successfully done at Ismailia, but in conditions which were extraordinarily favourable, such, as I fear, occur very rarely, if they occur at all, in India."

Colonel Leslie then referred to the operations against mosquitoes conducted at Mian Mir by Captain James and Lieut. Christophers. The latter reported that a distinct effect was produced upon the malaria of troops and on the endemic index of the bazaars. This was, however, only evident in the beginning of the fever season, and could not be maintained. The failure of the operations appeared to be due to the passage of adult anopheles into the area from without. All the Mian Mir experiment showed was that success in operations against mosquitoes is not so easily gained as some people say. Where drainage is perfect, as in the case of Ismailia, the inhabitants can exterminate mosquitoes with little trouble; but where drainage is non-existent or bad, as at Mian Mir, it is practically impossible, by any means at present within their reach, for the inhabitants to destroy the mosquitoes.

After dealing with the question of prophylaxis by quinine, Colonel Leslie proceeded to formulate a scheme for a permanent organisation to deal with malaria in India, viz. a committee in each province of three or more members to obtain information and supervise local inquiries, and perhaps to control the distribution of quinine. Each provincial committee would delegate one of their members to attend a meeting of a general committee in Simla, this general committee consisting of the provincial delegates, the Sanitary Commissioner, representing the Government of India, with Major James as secretary. The Government of India would appoint a scientific committee, and a certain number of workers would be under the scientific committee, and when necessary workers might be deputed to serve under the provincial committees.

Major James, I.M.S., introduced a discussion upon the distribution of malaria in India, and dwelt upon the necessity for an investigation similar to that which Captain Christophers made in the Punjab, which should be begun in every province. He concluded that there are not extensive areas in India in which anti-malaria measures are urgently required; he doubted if there were more than half a dozen considerable areas in the Madras Presidency which would come within this category.

Captain S. R. Christophers, I.M.S., read a paper on a new statistical method of mapping epidemic disease, with special reference to malaria, and confined himself to a discussion of the returns of the Punjab. He suggested that in each district a list of the more unhealthy *paraos* (rest camps) could be maintained, and operations commenced upon each in turn with a view to (1) destroy mosquitoes and larvæ and get rid of their breeding ground; (2) render the wells mosquito-proof; (3) issue quinine free to the local inhabitants, and to place it at all times within their reach free of cost. These operations should result in lessening the infectivity of such places. Captain Christophers also read a paper on malaria in the Punjab, in which he discussed quinine prophylaxis.

Major Chaytor White, I.M.S., considered that the recommendations of past malaria conferences are costly, and almost prohibitively so, if undertaken annually. More should be done in the propagation of fish which prey on mosquito larvæ.

Papers were also read by Lieut.-Colonel Thornhill, on malaria in cantonments; by Major James, on problems relating to the use of quinine; and Major Wilkinson brought forward a revised scheme for the distribution of quinine by Government.

At the termination of the conference various conclusions and recommendations were drawn up under the following main headings:—(1) scientific investigation; (2) the agency by which investigations should be made; (3) practical measures: (*a*) extirpation of mosquitoes; (*b*) quinine treatment and prophylaxis; (*c*) education; (*d*) finance.

ECONOMIC ENTOMOLOGY IN THE UNITED STATES.

MAPLE trees grown in the United States are liable to severe injury from defoliation by caterpillars. In addition to the fall web-worm (*Hyphantria cunea*, Dru.) and tussock moth caterpillar (*Hemerocampa leucostigma*, Dru.) there is a common and troublesome species known as the green-striped maple-worm (*Anisota rubicunda*, Fab.), which attacks maples of all kinds, and feeds occasionally on box-elder and oak. In a bulletin recently issued by the United States Department of Agriculture Bureau of Entomology, the latter pest is described in some detail by Messrs. Howard and Chittenden. In another publication they describe the leopard moth (*Zeuzera pyrina*, Fab.), the larvæ of which cause severe injury to many deciduous trees in northern New Jersey and eastern New York. It has been successfully combated in the public parks of New York City by injecting carbon disulphide into the larval burrows in the bark. Mr. Chittenden describes the rose-chafer (*Macrodactylus subspinosus*, Fab.), a long-legged beetle of a light yellowish-brown colour, which appears suddenly and in vast swarms in certain years, usually towards the middle of June in the northern States and about two weeks earlier in the southern, overrunning vineyards and orchards, nurseries and gardens. In about a month or six weeks from the time of their first arrival, generally after they have done a vast amount of damage, the beetles disappear as suddenly as they came. No successful means of combating them is yet known, the difficulty being that any process, to be successful, must be applied almost continuously.

The control of the pear-thrips (*Euthrips pyri*, Daniel) has been for several years the principal problem confronting the growers of deciduous fruits in portions of central California. This insect, on account of its mode of attack and habits, has presented unusual difficulties in control. Adults emerge from the ground in late February and early March, just when most trees are breaking into bloom. Eggs are usually deposited in the blossom, fruit stems, and leaf petioles. The larvæ, after hatching out, feed for two or three weeks, then drop to the ground, where they form a tiny protecting cell, within which they remain during the rest of the year. The pupal changes take place within this cell in the ground during October, November, and December. As measures of control, Mr. Dudley Moulton recommends winter cultivation followed by March and April spraying with tobacco extract.

The life-history of the greenhouse thrips (*Heliothrips haemorrhoidalis*, Bouché) is described by Mr. H. M. Russell. The damage caused by this insect is confined to the foliage of ornamental plants. Adults and larvæ both obtain their food by puncturing the epidermis of the leaf with their sharp mouth-parts and sucking out the sap. Fumigation with nicotine or with hydrocyanic acid gas were found to be effective methods of control.

Mr. A. L. Quaintance, who is in charge of deciduous fruit insect investigations, describes a new genus of Aleyrodidæ, *Paraleyrodes* (*aleurodicus*) *perseae*, Quaintance, found on orange trees and other plants in Florida. The adult is buff or pinkish in colour, and marked with white. The wings are whitish and lie almost flat along the dorsum, but do not meet along the middle line. A large amount of flocculent white wax is secreted over the leaf surface in the depressions in which the sluggish adults rest. From the same section of the Bureau is issued a description, by Mr. Hammar, of the cigar-case bearer (*Coleophora fletcherella*, Fernald), which damages the foliage and fruit of apple and pear trees. The name is given because of the curiously shaped cases, resembling cigars, made by the larvæ. Arsenical sprays were found effective in keeping it down. Messrs. Foster and Jones publish some additional observations on the lesser apple-worm (*Enarmonia prunivora*, Walsh), which is prevalent throughout the apple-growing district east of the Rocky Mountains. Late broods do a considerable amount of damage in autumn, and some of the larvæ work in the fruit for weeks after the crop is harvested. The methods adopted for keeping down the codling moth have, so far, proved effective in checking serious injury by this pest.

The regions of Virginia surrounding the Chesapeake Bay probably produce more early potatoes than any other part of the eastern States, the annual value of the crop approaching 6,000,000 dollars. Little damage is caused by blight, but the Colorado potato-beetle (*Leptinotarsa decemlineata*, Say) is a serious pest, and only very crude methods are adopted for keeping it in check, because of the prevalence of negro labour and the scarcity of capable white help. Mr. Popenoe gives a description of the pest and of the damage it does, and describes experiments in which three applications of lead arsenate mixed with Bordeaux mixture, the first about the time the eggs begin to hatch, and the others at intervals of three weeks, sufficed to control it.

Some new breeding records of the coffee-bean weevil (*Araecerus fasciculatus*, De Geer) are published by Mr. Tucker. He found the larval and pupal stages in some dried maize stalks, and obtained evidence that the insect causes injury to the maize plant. The attacks begin in the green stalks before the corn matures, and thus cause stunted ears. This weevil has also been found in the berries of the China berry tree.

Stringent laws are in operation in most of the States with regard to the importation of nursery stock. It is commonly necessary to notify the State entomologist within twenty-four hours of the arrival of the stock, and to fumigate satisfactorily. The laws of the different States are not all alike, and Mr. Burgess has collected in a short pamphlet the requirements which must be complied with by those making inter-State shipments of nursery stock. The pamphlet will form an interesting study for those who are agitating for some State supervision in this country.

THE METHODS OF MATHEMATICS.[1]

THE position assigned to mathematics in the educational system of every civilised country seems to mark it out as an essential element of mental culture, but an examination of the arguments that have been put forward from time to time to justify this position reveals a diversity of view that is at first sight disquieting.

Of those who acknowledge the value of mathematics there are many who see that value almost solely in its usefulness, in the help it brings to other sciences. Not unnaturally, those who are absorbed in the work of applied science are apt to turn away from the more abstract developments of modern mathematics; even the men whose special pursuits call for constant applications of mathematical processes, as in physics and engineering, can hardly be blamed if they lay special emphasis on those elements of a mathematical training that are of immediate application to their daily work. Yet it is not this aspect of mathematics that is usually present to the professional mathematician when he seeks to uphold the position of his subject in an educational system.

Mathematics may be assigned its place for a different reason. To those who reject the argument from utility, mathematics is not the humble auxiliary of other sciences, but is itself the one genuine science; it often comes to the aid of other sciences, but does not depend for the justification of its existence on the help it may be able to bring. From the adherents of this view come the familiar arguments for the disciplinary value of a mathematical training in which deductive logic is given a prominent place.

The question naturally arises whether these two aspects of mathematics are incompatible. To the teacher, whether in school or in college, the question is of prime importance; for the whole scheme of study and the methods of instruction will be found in the long run to be determined by the general attitude that is taken up with respect to the value of the subject. At the present time there is considerable uncertainty in the minds of teachers regarding the methods of school mathematics, and many of the older men are disposed to look unfavourably on recent changes as tending to impair the disciplinary effects of a mathematical training.

It may help us to understand more clearly the points at issue if we consider for a little the trend of mathematical inquiry during the nineteenth century. It is not necessary that I should sketch even in the roughest outline the development of mathematical science in that period; it will be sufficient for my purpose to indicate one dominant feature of the mathematical methods that were introduced in the early years of that century and that revolutionised the treatment of pure mathematics before it had reached its close.

During the eighteenth century the infinitesimal calculus and the doctrine of infinite series enabled mathematicians to investigate problems, intractable by the older methods, with a facility that led to a wide extension of the field of mathematical inquiry and to an enormous accumulation of results. In this period interest was centred less in demonstrations than in results, which were often reached by methods of a strange character, and sometimes, indeed, seem so absurd in themselves that we find it hard to understand how they were ever promulgated. Induction played a most important part in the discovery of theorems, and these inductions were often made from insufficient data and too seldom verified by subsequent tests. When the novelty of the processes had worn off, the necessity for a critical examination of their legitimacy became evident, and this examination was one of the tasks of the nineteenth century. It should be noted, however, that the great critics were also great creators; the criticism of the methods of mathematics was accompanied by a wide extension of its domain.

Of those who first saw the necessity for criticism and set themselves to the task were Gauss, Cauchy, and Abel. Gauss was first in the field, but, for various reasons, his work was long neglected. It was not until the publication in 1821 of Cauchy's "Cours d'Analyse" that the attention of mathematicians was effectively directed to the question.

Geometry in the hands of the Greek mathematicians had been reduced to a system of logically consistent truth; from assumed definitions, axioms, and postulates the various theorems of geometry were derived by the methods of formal logic, and Euclid's "Elements" were for centuries the standard of mathematical rigour. Algebra, or, in modern terminology, analysis, was of much later growth, and Cauchy's reference to the rigour that is demanded in geometry simply means that the time had come when the revision of principles and methods that the Greek mathematicians had effected in geometry should be carried out for algebra or analysis. The eighteenth century was a period of great activity in the development of analysis, and it is not surprising that the pioneers of this development should have been more interested in the resources of the country they were opening up than in the roads they followed. Their methods of mathematical inquiry were not limited by the traditional canons of Greek geometry; they included induction as well as deduction, there was constant appeal to intuition, and general theorems in mathematics were often established from physical considerations. The usefulness of mathematics as an aid in the investigation of the phenomena of the material world was the predominating feature of the period. The aim of Gauss, Cauchy, Abel, and their coadjutors was, in general terms, to do for analysis what the Greeks had done for geometry, and to make mathematics an independent science by clearly defining its province, stating the postulates from which the science starts and developing the consequences by the laws of logical operation without appeal to extraneous considerations.

The work of scrutinising the methods of analysis was vigorously pursued throughout the nineteenth century, and exerted a far-reaching influence. The notion of continuity, which seems so naturally to attach to geometrical quantity, required to be formulated in such a way that it would be amenable to calculation. Current conceptions of number were too vague, and it was found necessary to analyse more carefully the notion of numerical quantity so as to frame definitions and to establish rules of operation for the continuous variable of analysis. The so-called imaginary numbers had been long in use, but their existence was of a precarious nature, and the right to use such numbers had to be justified.

As will be easily understood, many of these discussions are of a very abstract nature, but they have provided a solid foundation for the operations of mathematics, of geometry as well as of analysis.

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[1] From the inaugural address delivered on October 11 by Dr. George A. Gibson, Professor of Mathematics in the University of Glasgow.

The movement, however, was not without its disadvantages. Mathematics gradually became more and more abstract, and the relations of mathematics to the applied sciences tended to fall into the background. On one hand it was manifestly impossible for the physicist and the engineer to keep themselves abreast of the developments of pure mathematics; on the other, the rapid extension of physics and engineering made it difficult for the mathematician, even when he had the desire, to understand the problems in the investigation of which mathematics might have been useful. The mathematics of the secondary schools was not affected to any considerable extent by the critical movement, but it probably became more formal and lost contact with the applied sciences.

Towards the close of the century complaints were rife, especially among the engineering community, that mathematics had lost touch with reality, and demands were made for a radical change in the mathematical training of the schoolboy. The feelings of dissatisfaction were not confined to any one group, and men who represented the most widely separated interests took a keen and active part in the discussions. Many of the views expressed respecting the methods of mathematics were far from new, but the emphasis with which they were urged may perhaps be taken as an indication of the extent to which, in the opinion of many competent judges, the deductive element in mathematics had overshadowed all others.

It may be conceded that, in the claims that have often been advanced for the efficiency of mathematics as an educational instrument, far too much has been made of the deductive aspect of mathematical studies; but in view of what has been said about the character of eighteenth-century mathematical methods, the assertion that mathematics knows nothing of induction is surely inaccurate. It is besides, I believe, a complete misunderstanding of the critical school to suppose that induction is barred as a mathematical method. By induction I do not here mean simply what is called "mathematical induction" or that method of demonstration which shows that if a theorem is true in one case it is true for the succeeding one; I am using the word in the sense it generally bears in speaking of scientific method. Induction as a method of discovering new truths or generalising known theorems has always been recognised to be of very great value, and is in constant use in advanced as well as in elementary mathematics. The critical objection to it was solely in respect of its use in a *systematic* development of mathematical truth (Euclid's "Elements," for example, embody a systematic development of geometry in which the theorems are linked together by a chain of deductive reasoning). As Weierstrass, one of the greatest of the critics, says, "it is a matter of course that every road must be open to the searcher as long as he seeks; it is only a question of the systematic demonstration."

In any discussion of mathematical methods it is important to bear in mind that the conviction of the validity of a theorem is not dependent on any single method of proof, even though one may strive to furnish a demonstration that conforms to some prescribed system. In mathematics, as in other sciences, conviction comes from many quarters, and one might almost say that where higher mathematics enters into the work of the physicist or the engineer the conviction that comes from the logical consistency of a mathematical demonstration is less important than the conviction that is due to insight into the physical facts and to the perception of the correspondence between the mathematical representation and the data of experiment. I think that pure mathematicians have not always given due weight to the instinct of the trained experimenter, and that, for the physicist, the true source of the conviction of the validity of "existence theorems" is often to be found in the disciplined imagination rather than in the cogency of the mathematical analysis. On similar grounds the essential accuracy of many of the results obtained by eighteenth-century mathematicians may be explained; their practical instincts prevented them from pushing a theory or method too far.

Now if it be granted that induction is a recognised mathematical method, it is hard to understand how observation and experiment can be dispensed with, because these are essential preliminaries to induction. In the development of mathematical knowledge it is quite certain that the predominance of deductive methods was of comparatively late growth, and that in the earlier stages observation played the leading part. It is unfortunate that so little of the work of the early Greek geometers has been preserved, but it is undoubtedly the case that geometry in its beginnings was essentially surveying or mensuration, and many of Euclid's theorems were known long before they were incorporated in a systematic treatise. There was, in fact, a "natural history" stage in the development of scientific geometry which the perfection of Euclid's deductive treatise has tended to obscure. The stage in which geometry appears as a logically consistent system was preceded by a period in which geometrical theorems were discovered as the result of observation and the consideration of many particular cases; in this formative period induction based on observation had full scope.

The evolution of scientific algebra has followed similar lines. The introduction of fractions in arithmetic, for example, and of negative and imaginary numbers in algebra, was due to their convenience in handling practical problems; the rules for their use were usually established, so far as proof was considered necessary, by appealing to numerous particular cases. The logical consistency of the scheme of operations was seldom discussed; so long as a rule led to results which gave a solution of the particular problems under investigation the need for a systematic presentation was not even felt. This stage—the "natural history" stage—of the development of algebra is well known to us by the works that have been preserved of the early writers on algebra; it would perhaps be true to say that a great part of elementary algebra has not advanced in actual school teaching beyond this stage.

The advance of mathematics to the position of a logically consistent system of truth has thus been governed by the same principles as regulate the progress of every science. Induction based on observation and confirmed by tests or verifications was constantly employed in extending the range of the science, and it was only gradually that deduction became the predominant, though never the exclusive, method of mathematical study.

In the recent discussions on elementary mathematics the guiding principle that has emerged seems to me to be the explicit recognition of the essential part that observation and induction play in the acquisition of mathematical knowledge. With this recognition is associated the idea that in the early training of the pupil it is scientifically unsound and practically hurtful to emphasise the deductive element; his training should, in its broad outlines, be modelled on the course that the historical development of mathematics has followed. Mathematics has now reached the stage in which it is possible to treat it as a deductive science, but it does not follow that it is either necessary or possible to teach it to beginners entirely as a deductive science. To do so is to mistake the meaning of its history and to deprive it of its place as an exponent of scientific method. Observation, classification, and induction are essential elements of scientific method, and these are well illustrated in the historical development of mathematics. The recent discussions have shown that, in the opinion of many experienced teachers, it is not only possible, but necessary, to make full use of these methods in mathematical teaching, and the conviction is widely held that they are of special importance in geometry, the branch of elementary mathematics where deduction has so long had the leading place. The excellence of the intellectual discipline to be obtained from a study of Euclid is, in my opinion, not to be questioned, but I think there is no doubt that it is contrary to all scientific order to take Euclid as our guide for an introduction to geometry. It is necessary for the pupil to acquire a knowledge of the forms of material objects before he can reasonably be expected to demonstrate the geometrical properties that are implied in the definitions of geometrical bodies. In acquiring this knowledge observation and classification are essential, and deductive reasoning will have little place. The knowledge thus gained may be quite entitled to the name of scientific; if the course is carefully planned and carried out, it will be quite possible to obtain a system that is not a mere aggregate of isolated details, but a coherent structure. The importance of a practical course is now generally recognised in its bearing on deductive geometry; its value, however, in relation to the appreciation of scientific method is equally great.

The early stages of algebra are usually found to be very difficult, and are too often of little scientific value; the subject is more abstract than geometry, and the temptation to let the teaching degenerate into a mere mechanical application of rules is very great. I cannot but think, however, that the spirit of De Morgan's chapter on "The Study of Algebra" in his book "On the Study and Difficulties of Mathematics," written so long ago as 1831, is in full accord with scientific method, and is worthy of being more completely realised in practice than it has yet been. I cannot refrain from quoting a few sentences that indicate his view of the way in which a reasonable conviction may be obtained. After pointing out the value of *mathematical* induction, he says:—"The beginner is obliged to content himself with a less rigorous species of proof though equally conclusive as far as moral certainty is concerned. Unable to grasp the generalisations with which the more advanced student is familiar, he must satisfy himself of the truth of general theorems by observing a number of particular simple instances which he is able to comprehend. For example, we would ask anyone who has gone over this ground whether he derived more certainty as to the truth of the binomial theorem from the general demonstration (if indeed he was suffered to see it so early in his career), or from observation of its truth in the particular cases of the development of $(a+b)^2$, $(a+b)^3$, &c., substantiated by ordinary multiplication. We believe firmly that to the mass of young students general demonstrations afford no conviction whatever; and that the same may be said of every species of mathematical reasoning when it is entirely new."

There can, I think, be no doubt that it is now generally recognised that it is in accordance with true scientific method to keep the purely deductive element in the background so far as the early training in mathematics is concerned, and that by so doing the general methods characteristic of scientific procedure are more fully illustrated. This recognition, however, does not imply that the characteristically deductive side of a mathematical training is to be neglected; it means rather that deduction, which is surely a scientific method, will be used with a fuller comprehension of its place and even of its necessity. The time and the manner of the passage to deduction are not to be easily decided; much depends on the pupil, and it is one of the hardest tasks of the teacher to determine the appropriate correlation of methods. Induction is essential as an instrument of research, but deduction is also essential to the systematic development of mathematical science, and no training in mathematics can be considered satisfactory that does not show the complete process by which mathematical knowledge advances from the stage of observation to that of a science in which deduction plays the principal part in the coordination of its contents.

In this conception of elementary mathematics we have the leading characteristics of scientific method, and have them, as I think, in great simplicity. It is on this ground that the study of mathematics seems to me to be a valuable, if not indeed an essential, factor of modern education. Science has effected a great revolution in the material conditions of life, but it has also produced a profound change in the mental attitude of all thinking men. Our civilisation is not intelligible unless account is taken of the influences, material and intellectual, that are due to the progress of science. The right study of mathematics, even in its humblest forms, offers an easily accessible road to the appreciation of the fundamental characteristics of scientific method.

It is of interest to note further that the more recent methods of treating elementary mathematics, which are inductive rather than deductive in their character, lead in a natural manner to an appreciation of some of the cardinal ideas and methods of pure mathematics. Thus the notion of a continuously varying function, the conception of a limit and the method of successive approximation, cannot fail to be impressed upon a pupil who has been adequately disciplined in graph tracing.

The complexity of the problems confronting modern scientific research, with the vast accumulation of detail so characteristic of it, demands a careful training in the discrimination of the essential from the accidental, in the search for the underlying principles that coordinate or explain the details, and in the selection of the most general points of view from which to survey the field that has been worked. In this training, quite apart from the direct utility of the more advanced mathematical processes, much assistance is to be obtained from a mathematical course; the processes of thought involved in any serious study of mechanical or physical phenomena have much in common with those developed in the study of mathematics. It is the special task of the teacher to determine the extent to which the rigorous methods of pure mathematics are to be carried. Rigour is relative, not absolute, and will always be conditioned by circumstances of subject and person, and even by the prevailing fashions of the day. Restrictions corresponding to the nature of the subject and to the intellectual development of the student have always been recognised as essential. Many assumptions are either tacitly or explicitly made, fundamental theorems the demonstration of which offers special difficulty are frankly taken for granted until the necessity or the expediency of their demonstration arises and the logical completeness of a course is therefore impaired; but progress is all but impossible on any other lines, and much may be gained from demonstrations that are in parts confessedly incomplete. The real danger to the student lies in a demonstration that has the appearance of being complete and yet conceals serious assumptions. It is a great advantage that in mathematics general theorems can often be tested by particular cases that are easily handled, and practice of this kind will often produce that working conviction which is so essential for fruitful applications. One is reminded in such cases of the saying attributed to D'Alembert, "Go forward and faith will come to you."

Up to this point I have been considering the methods of mathematics almost solely in relation to the function of mathematics as a factor of general education or as the auxiliary of the applied sciences in their more elementary stages. The considerations that I have thus hastily sketched seem to me to involve the conclusion that this phase of mathematics is to be justified neither by its usefulness alone nor by its disciplinary power alone, but by the degree to which the training combines these elements. In a properly balanced mathematical course the characteristic features of scientific method will receive due recognition, and the mental horizon of the learner will be gradually enlarged; but the choice of material and of method will prepare him for the application of mathematical processes in various fields, and the study as a whole will powerfully react on his mental development.

It must not be forgotten, however, that the claims of mathematics are not exhausted by such developments as I have indicated. I have deliberately avoided all reference to what is called pure mathematics, and have confined myself to those aspects of mathematical study that are of general interest. It is difficult for anyone who is not a professed student of mathematics to realise the position of the subject in its modern developments. The great critics of the nineteenth century were not less successful in extending the boundaries of mathematical science than in securing by a just title the territory acquired, and to-day the range of subjects that fall properly within the domain of mathematics has an extent that the contemporaries of Newton and Leibnitz never dreamed of. As the result of their labours mathematics ranks as a science worthy of cultivation for the intrinsic value of the conceptions which it embodies, for the appeal it makes to the constructive imagination, for the light it casts on the processes of thought, and for the inherent beauty of form that characterises many of the theories comprised within its domain; but any attempt at reviewing, within the limits of time allotted to me, the present state of the science would certainly fail to give any adequate conception of the nature of its contents. To the mathematical student, however, the assurance can be given that he need not fear that the science is complete and that all the problems it presents have been finally solved. Abstract as these investigations often are, there is ample room for the application of those general principles of scientific research which his earlier training will have helped to develop, and the final test of his mathematical powers will be found in the success with which he extends the scope and methods of the science.

Mathematics as we know it to-day is in living contact with experimental science on the one side; on the other it borders on the domain of philosophy; to each it has some contribution to offer, and in the words of Weierstrass "a mathematician who is not something of a poet will never be a complete mathematician." Is it not, then, a subject worthy of a place in university studies?

DEVELOPMENTS OF ELECTRICAL ENGINEERING.[1]

THIS address deals with a few only of the many recent developments in electrical plant and its application to industrial purposes.

Generators.

The modern tendency is to instal very large units. This is partly due to the large demand made on the power house and the desire to restrict the number of units, and partly to the fact that the advantages of the steam turbine over the reciprocating engine become more pronounced with the increased size of the unit. The General Electric Company of New York have built several turbo-alternators of 14,000-kw., and the British Westinghouse Company inform me that it would be quite feasible to build sets of 15,000 kw. up to 15,000 volts pressure. In water-driven alternators, also, the tendency is towards large units. Thus the power house of the Norwegian Nitrogen Company at Svälgfos, near Notodden, has been fitted with four turbine-driven three-phasers, each for 10,500 kilovolt-ampere, and developing 7000 kw. at 10,000 volts. It is obvious that in these circumstances special ventilating arrangements become necessary. Dr. Kloss, in a paper read before our Institution about a year ago, has pointed out that the scientific way of ventilating turbo-dynamos is to take the air from the outside and discharge it to the outside of the engine-room. It is important that only clean air be used, and for this reason air filters are built into the inlet ducts. These are formed of pockets of porous cloth extended over wooden frames, and so placed that the dust which settles on the cloth may be removed by beating or with a vacuum cleaner. Washing or chemical cleaning is only required after some years of use.

In most modern electricity works the circulating and air pumps are driven by electric motors, but this method has been replaced at the works of the Allgemeine Elektricitäts Gesellschaft by turbo-driven centrifugal pumps. No piston pumps at all are used, and the feed may be regulated without paying attention to the feed pump. The feed water obtained by this method is absolutely free from air, and only 5 per cent. of make-up for the feed is required. Since no piston engines of any kind are used, there is no need for oil filters.

An important development in turbo sets was initiated about ten years ago by Prof. Rateau with his exhaust steam turbine. The cost of adding exhaust steam turbo sets to an existing installation of large size may be taken at from 6*l.* to 10*l.* per kilowatt exclusive of thermal storage. The commercial advantage is considerable. Thus in the Osterfeld Mine a Rateau plant installed at a cost of 53,000*l.* has resulted in an annual saving of about 20,000*l.*

The desire to reduce the cost and complication of switchgear and to make paralleling easy has led to the use of non-synchronous machines as generators. The rotor may be a squirrel-cage of very simple construction and requiring hardly any insulation, no matter how high the pressure produced by the stator may be. The mechanical construction is easier than that of the revolving field of an ordinary turbo-alternator, and since the air space can be made small, the power factor is high. A 5000-kw. non-synchronous generator was last year added to the plant of the Inter-borough Rapid Transit Company, New York.

There is some difficulty in the design of turbo-alternators for very low periodicity, since the speed becomes insufficient for the satisfactory working of the turbine. To meet such cases Mr. E. Ziehl has devised a type of alternator which he calls a "double-field generator." The principle may be explained as follows: Imagine a non-synchronous motor having precisely the same three-phase winding in stator and rotor, and let the circuits be connected either in series or parallel in such way that a three-phase current sent through the machine will produce fields which in stator and rotor revolve in opposite sense. If now the rotor be driven by power in a sense opposite to that of its own field and with a speed corresponding to twice the frequency, the field produced by the rotor currents will in magnitude and direction of motion be identical with that produced by the stator currents. Thus each of the two windings contributes one-half the field common to both. At the same time the demagnetising action of each winding is eliminated by that of the other. Since the E.M.F. is generated in both windings, only half the flux as compared to a synchronous generator is required; hence less hysteresis loss, smaller radial depth of stampings, and less copper weight. The paralleling is easy; the speed need only be approximately right, and if coupled up in a wrong phase position no damage is done, since the inductance is then very great.

Transformers.

In transformers also there is to be noticed a general tendency towards large units, which is not surprising if one considers that for the calcium-carbide industry alone about half a million horse-power in generating plant has been installed throughout Europe, and that most of the power has to flow through transformers to the carbide furnaces.

The General Electric Company of America have built several 10,000-kw. three-phase transformers working at 60 frequency, and giving a pressure of 100,000 volts. The largest European transformers of which I could find a record are some made by the Siemens-Schuckert Werke. They are three-phase 6750-kilovolt-ampere capacity oil cooled, for 66,000 volts on the high-pressure side. The use of oil as a filling medium has made it possible to build transformers for very high pressure. In one American power-transmission plant now under construction the step-up transformers are intended to raise the pressure to 110,000 volts, but even higher pressures can be obtained. Transformers giving extremely high pressure on the secondary are used for testing insulators and insulating material. A transformer of this kind has recently been made by Messrs. Brown-Boveri. It is a 50-kilovolt-ampere transformer wound for a primary pressure of 1000 volts and giving on the secondary 250,000 volts, but even this has been exceeded when the transformer was used in testing the dielectric strength of insulators. From a curve referring to such tests which the makers have sent me I find that the highest pressure recorded was 310,000 volts.

The reduction in weight of transformers due to the use of alloyed iron, large units, and vigorous cooling is very remarkable. As an example of good modern practice, I take a Brown-Boveri transformer where the active material weighs only 3·1 kg. per kilowatt, and the efficiency is 98·6 per cent. at full non-inductive load. In an Oerlikon 3500-kw. transformer the active iron only weighs 7 tons, being at the rate of 2 kg. per kilowatt output. The largest self-cooling oil transformers of which I know are some 1200-kw. three-phase 40-frequency 5000-volt transformers made by the British Westinghouse Company, but for larger unit artificial cooling becomes necessary.

For furnace work it is well to allow a rather large inductive drop so as to reduce the rush of current in the event of a short circuit in the furnace. This means wide spaces between primary and secondary coils, but it also involves the necessity for good mechanical support. The mechanical forces acting on the individual coils may become considerable, and this is probably the reason why some makers prefer the core type with concentric cylindrical coils, the cylinder being the best shape for resisting radial forces.

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[1] Abridged from an address delivered before the Institution of Electrical Engineers on November 11 by Prof. Gisbert Kapp, president of the institution.

Motors.

In three-phase motors for railway work, speed regulation has hitherto been obtained either by some kind of cascade arrangement or by changing the number of poles. In either case the rotor has slip-rings, a complication one would gladly avoid. This is now possible, thanks to an ingenious design worked out by Mr. Aichele, the chief designer of Messrs. Brown-Boveri. The motor has been applied in their latest Simplon locomotives. Its rotor is simply a squirrel-cage, and has no slip-rings and no outside electrical connections whatever. The stator has two distinct windings, one for 16 and the other for 12 poles, and each winding can by means of a pole-changer be so grouped as to produce half its normal number of poles. There are thus four normal speeds possible, corresponding respectively to 16, 12, 8, and 6 poles, or to a train speed of from 26 to 70 km. per hour.

A remarkable improvement in single-phase motors has been devised by Mr. Deri, and practically developed by Messrs. Brown-Boveri. Mr. Deri's motor is a "repulsion-motor," with movable *and* fixed brushes. The effect of shifting the former is analogous to changing the impressed voltage on an ordinary continuous-current series motor, and thus by adjusting the brushes the torque and speed may be regulated. This property renders the Deri motor valuable in all cases where delicate speed regulation is essential. It is largely used for working passenger lifts and other hoisting machinery, and also for driving ring-spinning frames, the speed regulation in the latter case being automatic. The result of automatic speed regulation is an increased output from the ring-spinning frames. Another application is for electric railway working, to which I shall refer later.

The Electric Transmission of Power.

There has been a considerable development in this branch of applied electricity in late years, but the development has been on different lines in different countries corresponding to their various topographical, industrial, and commercial conditions. With us it is not so much a question of carrying power a long way as of distributing large amounts of power at numerous points within a restricted and densely populated area. In so-called water-power countries the distance between the source of the power and the points of its delivery is very much greater than in England, and hence the necessity of using much higher pressures in the transmission lines. In raising the pressure a limit is eventually reached at which dispersion of power becomes serious. This critical potential difference in virtual kilovolts is:—

$$\mathrm{KV}=\frac{0{\cdot}115b}{0{\cdot}5+r}\left(\frac{1}{1+0{\cdot}013v}\right)r\log\frac{s}{r}.$$

Here *b* is the barometric pressure in mm. of mercury, *r* is the radius of the wire in cm., *s* the distance between the two wires in cm., and *v* is Mershon's "vapour product," namely, the pressure of saturated steam in mm. of mercury at the given temperature multiplied by the relative humidity, or the ratio $\frac{\text{actual moisture}}{\text{possible moisture}}$.

The protection of power lines against pressure surges due to atmospheric or other causes is a very important matter.

It is well known that the connection of an underground cable with an overhead line constitutes a special danger to the cable from atmospheric discharges. To protect the cable, Mr. Semenza, of Milan, uses a kind of gigantic Faraday cage surrounding the point where the overhead lines are connected to the cables by transformers. The iron parts of the structure are earthed, the roof and the window-frames are of iron, and under the plastering of the walls there is iron netting. If a capacity and inductance tuned to somewhere near the frequency of the surge are placed in series and connected to line and cage, a current of that particular frequency will flow to earth as if the connection were direct. Even if the frequency were only approximately that to which the set was tuned, the reactance would not be excessive and the protection would be sufficient. Thus a set tuned to 1 million frequency would at 10 million frequency have a reactance of 158 ohms and at 100,000 frequency a reactance of 165 ohms. A set tuned to 100,000 frequency would at 20,000 frequency have a reactance of 192 ohms. A set for 1 million frequency may conveniently be formed of two Moscicki condensers in parallel, having together a capacity of 0·01 mf. and an inductance of 2·54 microhenry. The latter is obtained by two turns of 2 mm. copper wire 50 cm. in diameter. A set for 100,000 frequency would require eight condensers in parallel and a coil of ten turns. For the ordinary working frequencies up to 50 either set has of course a practically infinite reactance, that is to say, it has no effect on the power current. The Milan translating station has been at work now for about two years with perfect success. It should be noted that the system not only protects against lightning discharges, but against any abnormal rise of pressure, in so far as this is caused by a high-frequency surge.

Whilst on the subject of safety devices in connection with power transmission, I must refer to another recent invention, the object of which is the prevention of the infiltration of high-pressure current into low-pressure lines. That such a device is urgently needed is shown by the lamentable accident which happened last August in Olgiate, where several persons were killed by contact with nominally low-pressure lighting circuits. The danger of a short or a leak between high- and low-pressure circuits does not lie in the transformer. This can be made absolutely safe; but the switches and leads to the transformer, and especially the outside lines where there are miles of them, are a source of danger. A broken wire or a branch of a tree blown across two lines by the wind are possibilities from which no excellence of workmanship can guard us. Some means should therefore always be provided to cut off the current automatically in the low-pressure circuit as soon as its potential to earth exceeds a predetermined limit. Such an instrument was perfected last year by Mr. Arcioni, of Milan, and is now being gradually taken up on the Continent. Last year I tested the Arcioni safety device on the Milan system, making artificial leaks from the 6000-volt network to a local secondary lighting circuit, and found the action absolutely trustworthy.

The commercial development of electric power distribution on a large scale in this country by companies established for this purpose may be said to have begun with the present century. The public generally, and even some engineers, are still under the impression that a country of abundant water-power offers better opportunities for electric power distribution than a country of cheap coal, but that this is in reality not so is demonstrated by the great development which power supply has reached in this country. In the country of waterfalls industries have to be introduced in order to utilise the power made available through electric transmission, whilst in the coal country highly developed industries of different kinds are already there. As regards capital outlay, the advantage lies generally with the thermal station, quite apart from the extra cost of a steam reserve, which, for at least part of the power, in many cases is unavoidable. If, then, we speak of the cheap water-power of Swiss and Italian hydro-electric works, we do not mean that those works can produce power more cheaply than English thermal stations, but that they can produce it more cheaply than if they had to use imported coal.

Although in this country we have only little water-power, the deficiency is made up by other sources of energy which now mostly run to waste. Mr. C. H. Merz estimates that within the area served by the North-east Coast Power System the gas obtained as a by-product of the coke ovens could be made to yield continuously 150,000 horse-power if burned under boilers, and 250,000 horse-power if used in internal-combustion engines. It is the merit of Mr. Merz to have recognised the enormous commercial importance of these sources of energy, and to have already made a beginning with their utilisation by the establishment of what he calls "waste heat stations."

Electric Railways.

For main lines alternating current is unavoidable, and the only question on which there may be still difference of opinion is whether the current shall be three-phase or single-phase. Electricians prefer the former, railway men the latter mainly on account of the greater simplicity of the overhead work. As the railway men are in reality the customers who give the order to the electrical engineer, it seems likely that the single-phase system will be the one more generally adopted; and, indeed, a very respectable beginning has within the last four years already been made on the Continent, where single-phase vehicles aggregating more than 100,000 horse-power are at work or on order.

In Italy considerable progress is also being made. The Government has decided to electrify eleven sections on the State Railways, aggregating 337 miles of track, but on the three-phase system. Thus the battle of the phases is still undecided. The decision of the Italian State Railways to use three-phases, whilst in Germany, Austria, England, Sweden, and America the single-phase system is preferred, is highly interesting. Mr. Verola, the chief engineer of the electrical department of the Italian State Railways, was good enough to explain the reason for this choice. The following is an abstract of his letter:—

"In the case of the three lines (Pontodecimo-Busalla, Bardonecchia Modane, and Savona-Ceva) which are about to be opened, the service is extremely heavy, trains of 400 tons and over having to be hauled up on long grades of 25 to 35 per mil. at a speed of 45 km. per hour. With the three-phase system it is possible to comply with these conditions by using two locomotives. These weigh each 60 tons, and develop each at the 1-hour rating 2000 horse-power. With the single-phase system the weight of the motors would be at least doubled, resulting in a greater expenditure of energy. The advantages of wider speed adjustment in running and better efficiency in starting are not of importance on these lines. It is probable that also some future electrifications will be on the three-phase system, notably that of the prolongation of the Valtellin line to Milan, which will shortly be taken in hand. It is, however, highly probable that some other lines will be worked single-phase. One of these is the line Turin-Pinerolo-Torre-Pelice, where widely different speeds are necessary, the maximum being 80 km. per hour for 100-ton passenger trains."

In Switzerland the Federal Government appointed some years ago a committee of electrical and railway engineers to report generally on the question of electrifying the Swiss railways. The first report dealt with the amount of power required, the second some standards connected with the future electrical service, whilst a third report dealt with the question of a standard frequency, but on the question whether the single- or the three-phase system is to be chosen the committee has not yet pronounced an opinion. From private conversations I have had with Swiss railway men, I incline to the belief that the decision will be in favour of the single-phase system, especially since, by the use of the Deri type of motor, it has been found possible greatly to simplify and also lighten the accessory equipment. The first test of this motor for traction was made on the three-phase Engelberg railway, one phase only being used. No resistances, auto-transformer, contactors, regulating switches, or controllers of the usual construction are required. The starting and the regulation of the tractive force and speed is effected simply by shifting the brushes. Thus all the driver has to do is to attend to a hand-wheel, the motion of which is transmitted to the brush rockers by positive mechanical gearing.

Winding Engines and Rolling Mills.

Dynamic storage in some such way as first applied by Ilgner to winding engines, and voltage regulation on what may broadly be called the Ward-Leonard system, have made it possible to satisfy the very severe conditions under which winding engines and rolling mills have to work. A good example of modern English practice in direct-current rolling-mill electrification is the plant supplied by the Electric Construction Company, Ltd., of Wolverhampton, to the steel works of Sir Alfred Hickman, Ltd., of Bilston. The makers have given me the following particulars:—The flywheel set consists of a 2000-horse-power direct-current motor, two 28-ton flywheels and two generators capable of giving any voltage between −1000 and +1000 volts. The excitation of the motor is adjusted automatically so as to produce a speed variation of the flywheels between 290 and 350 revolutions per minute. The energy given out when dropping from the higher to the lower speed is 46,000 horse-power seconds. This set supplies power to a cogging and a barring mill. The cogging-mill motor works a 30-inch mill, and when cogging down ingots of 3 tons weight has to develop 4800 horse-power, and for two-second periods once an hour 9600 horse-power. The barring-mill motor works a 24-inch mill, and has to develop 6000 horse-power, and for two-second periods once an hour 12,000 horse-power. The maximum speed is 120 revolutions per minute, and the time occupied in reversing from maximum speed in one direction to that in the other direction is six seconds. As an example of a reversible mill driven by three-phase current I take that supplied by the British Thomson-Houston Company, Ltd., to Messrs. Dorman, Long and Co., Ltd. It is a cogging mill with rolls 28-inch centres, and the normal speed is 70, the maximum speed 90, revolutions per minute. The flywheel set consists of a three-phase 950-horse-power non-synchronous motor, coupled to a 1000-kw. 400-volt direct-current generator and a 30-ton flywheel. The speed limits are 400 and 480 revolutions per minute, and the maximum peripheral speed of the flywheel is 295 feet per second. The mill motor is rated at 1200 horse-power, and has an overload capacity for short periods of 3600 horse-power. The time required for reversing from full speed in one direction to full speed in the other direction is four seconds. The mill deals with 1800-lb. billets 12 inches square, reducing them to 3-inch square bars in fourteen passes. The output is 15 tons per hour.

Electric Steel Furnaces.

In the manufacture of steel from pig and the refining of steel electrically the experimental stage has long been passed, and the practical results obtained are eminently satisfactory. Even where, owing to the price of power, the electric process is no cheaper than the thermic process, the former enables the steel refiner to achieve results with certainty and regularity which under the old methods are hardly attainable at all, or only, so to say, by good luck.

In the furnace electricity is merely used to produce a large amount of heat locally. All furnaces are worked with alternating currents, the heat being produced either in an arc or by the passage of the current through the metal itself. In an arc furnace for a capacity of 2 to 3 tons the average energy required per ton of finished steel is about 1000 kw.-hours when the charge is introduced cold, and about 400 kw.-hours when it is introduced in a molten state.

A drawback inseparable from the employment of electric arcs is the great fluctuation in the load, making it impossible to work an arc furnace from a circuit which supplies other consumers. This difficulty is overcome with the so-called "induction furnace," where the heating is by ohmic resistance. In the latest type of induction furnace the energy required per ton of steel if the charge is introduced in a molten state is 125 kw.-hours for rails and 250 kw.-hours for tool steel.

The electric furnace for steel making and steel refining is now an important accessory in steel works, and thousands of tons of steel are produced annually, both in furnaces of the arc and in those of the induction type.

Fixation of Atmospheric Nitrogen.

Of the many methods devised for fixing atmospheric nitrogen with the object of producing a fertiliser to replace Chili saltpetre, I can only refer to three which have attained considerable importance.

The Birkeland-Eyde process is in use in the Notodden factory. This is fitted with four 7000-kw. generators and thirty-two furnaces, and has a yearly production of 20,000 tons of nitrate of lime, and a second factory on the Rjukan Fall is in course of construction.

The Frank-Caro process is not, strictly speaking, electrical, yet it has only become commercially possible by the aid of electricity. The raw materials for this process are calcium carbide and nitrogen, the former being produced by electricity in the well-known way, and the latter by liquefying air in a Linde machine and subsequent fractional distillation. The carbide is brought to glowing heat in a closed, externally fired retort, and the nitrogen passed through. The reaction is $CaC_2 + N_2 = CaCN_2 + C$.

A new process for the production of nitrous compounds, which is the invention of Messrs. Schoenherr and Heszberger, is being introduced on a large scale in Norway by the Badische Anilin- und Sodafabrik. In this process air is passed through an iron tube in which an alternating-current arc of 5-metre length is maintained under a pressure of 4200 volts. The air enters one end of the tube by a series of tangential holes, and the rotary motion thus produced keeps the arc confined to the axis of the tube. Each arc absorbs 600 horse-power.

Electricity in Agriculture.

The discovery that electrification of the atmosphere immediately above the plant stimulates in certain cases its growth is now being utilised practically under a system worked out by Sir Oliver Lodge, in collaboration with Mr. J. E. Newman and Mr. R. Bomford. A network of galvanised iron wires is stretched over the field to be treated, and suspended 18 feet from the ground from wooden posts and oil insulators. The posts are placed 70 yards apart, so that about one post per acre is required. The network is positively electrified to from 60,000 to 100,000 volts by means of an induction-coil mercury gas break and Lodge rectifying vacuum valves. The induction coil is worked on the primary side by continuous current obtained from an ordinary dynamo. The amount of primary power required per acre is very small, namely, from 10 to 20 watts. The installation is run for five or six months during eight to ten hours each day, and the total expenditure of energy is only about 20 B.O.T. units per annum per acre. Under this treatment the increase in the yield per acre is about 30 per cent., but under certain conditions it may be even more. The system is in use on several farms in this country, on six farms in Germany, and on one farm in Holland.

In the time at my disposal I have only been able to refer to a few of the industries which have benefited by the application of electricity; but when one reflects that nearly every industry in the country has been, or might be, furthered by the use of electricity in one form or another one comes to see that an enormous field of useful work is open to the electrical engineer—not only useful to himself, but even more so to the interests that employ him. How, then, comes it that electrical engineering is not so prosperous as it might be? Some of our members say because we are backward as compared with our foreign competitors. If by that term they mean that our electrical engineering works cannot produce equally good plant as our rivals, I cannot agree. I have frequently visited Continental shops, and, although I am quite willing to admit that excellent work is done there, I am also convinced that British shops can turn out work equally well and generally at a slightly lower prime cost. There is certainly no justification in reproaching the makers of electrical plant with backwardness; and, moreover, it is bad business policy. If, however, the reproach is levelled against the potential users of such plant there is some justification, and also a reason. Our great staple industries are old-established and have been fairly prosperous for generations; those on the Continent are of recent growth, and had to struggle into existence against English competition. To become successful they had to adopt every improvement which science put at their disposal. With them the application of electricity is almost a vital matter; with us only a desirable improvement. Is it, then, to be wondered at if a works manager or owner, who has grown up in the pre-electric days, and has been doing a prosperous business ever since, should be rather slow in embarking in new methods of working which, to his thinking, might entail the possibility of risk and the certainty of greater mental exertion? There are, of course, exceptions, and a good many of them, as witnessed by the great strides which electrical methods applied to our staple industries have already made; but, compared to what the development might be, we must admit that we have as yet only touched the fringe of this vast field. There is progress, but it is not fast enough, and to accelerate it we must educate the potential users of electrical plant. A beginning in this direction has already been made by the managers of electric-light stations. They are educating the householder by local exhibitions and literature that he can understand. On the Continent every large electrical engineering firm has a literary department, the business of which it is to educate possible customers. No sooner is a new winding plant started, or a cotton mill electrically equipped, than well-written, well-printed, and beautifully illustrated leaflets are sent out into the world to tell possible clients of the work done by the firm. Here, such literary departments are the exception; and thus it comes about that we hear so much of the great advances made on the Continent and so little concerning equally good work done here.

Our institution can also do something to accelerate the introduction of electricity into our great industries. It is no doubt very useful if we in our meetings read highly technical papers, and thus educate each other; but this is only part of our work. The other part is to educate the customer, and for this purpose we possess in our organisation of local sections the requisite machinery. By arranging for papers which shall be of interest to the particular industries carried on in the district of each local section, our institution can further the adoption of electricity in these industries, and this will not only be to our own advantage, but even more to the advantage of those whom we serve.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The professorship of biology will be vacant on January 1, 1910, by the resignation of Prof. Bateson as from that date. Candidates for the professorship should communicate with the Vice-Chancellor on or before Monday, January 10. The professor will receive a stipend of 700*l.* a year, with the usual deductions in case he holds a fellowship. It will be the duty of the professor to promote by teaching and research the knowledge of genetics.

The Balfour studentship will be vacant at Christmas, 1909. The names of applicants, together with such information as they may think desirable, should be sent on or before January 15, 1910, to the secretary, Mr. J. W. Clark, Registry of the University, Cambridge.

Dr. Whitehead has been appointed chairman of the examiners for the mathematical tripos, part i., 1910.

Mr. W. B. Hardy has been nominated a manager of the Quick fund from January 1, 1910, to December 31, 1915.

The electors to the Isaac Newton studentships give notice that, in accordance with the regulations, an election to a studentship will be held in the Lent term, 1910. These studentships are for the encouragement of study and research in astronomy (especially gravitational astronomy, but including other branches of astronomy and astronomical physics) and physical optics. The studentship will be tenable for the term of three years from April 15, 1910. The emolument of the student will be 200*l.* per annum, provided that the income of the fund is capable of bearing such charge. Candidates for the studentship should send in their applications to the Vice-Chancellor between January 16 and 26, 1910, together with testimonials and such other evidence as to their qualifications and their proposed course of study or research as they may think fit. Candidates are recommended to send with their applications an account of any work bearing on astronomy or physical optics on which they may have been engaged, and to forward copies of any papers they may have published on these subjects.

The special board for moral science directs attention to the urgent need of more adequate accommodation for the laboratory of experimental psychology. Since 1897, when the lectureship in experimental psychology was first established, this department has been successively housed in various temporary quarters, all totally unfitted for the purpose. At Oxford an excellent laboratory devoted to experimental psychology has recently been erected, presided over by a reader, who is a Cambridge man. This laboratory was built and is maintained at the expense of the University. The board is of opinion that it is essential that a similarly permanent and satisfactory building should be provided without delay in Cambridge if instruction and research in this important new subject are not to cease.

Birmingham.—The Huxley lecture this year is to be delivered on December 1 by Prof. W. Bateson, F.R.S., who has selected "Mendelian Heredity" as the subject of his address.

Mr. Francis Darwin, F.R.S., Prof. Westlake, of Cambridge, and Prof. Holland, of Oxford, have been created Doctors of the University of Brussels. Mr. Darwin has also been made a corresponding member of the Institut National of Geneva.

The Brussels correspondent of the *Times* states that a great scientific meeting was held on November 21 at the Solvay Institute in connection with the Brussels University celebrations. A cheque for 160,000*l.* was presented on November 19 by the friends of the University.

Dr. D. Waterston has been appointed professor of anatomy in King's College, London, in succession to Prof. Peter Thompson, appointed professor of anatomy in the Birmingham University. Dr. G. C. Low has been elected lecturer in parasitology and medical entomology.

The new botanical laboratories at University College, London, will be opened on Friday, December 17, by Dr. D. H. Scott, F.R.S. The Vice-Chancellor (Prof. M. J. M. Hill, F.R.S.) will preside. Applications for tickets of admission should be made to the secretary, University College, London, W.C.

At a meeting of the East London College committee on November 16 a subcommittee was constituted to administer the fund for the encouragement of research work at the college, upon which Mr. H. F. Donaldson, C.B., Dr. H. A. Miers, F.R.S. (principal of the University of London), and Sir William White, K.C.B., F.R.S., were asked to serve.

A copy of the October issue of the *Battersea Polytechnic Magazine* has been received. The periodical provides an interesting record of the doings of the various societies and clubs in connection with the institution, as well as readable articles by members of the staff and students. Great prominence is given to the work of the day section of the Engineering Society; the issue of the magazine before us, for example, contains full descriptive accounts of four visits to important engineering undertakings, in addition to complete particulars of the annual meeting of the society.

The School Board of Hartford, Connecticut, has decided to establish a "tent school" for children from homes where there is tuberculosis, and for children who suffer from anæmia or curvature of the spine. The tents will be put up on some vacant ground in the neighbourhood of one of the city's school buildings. Accommodation will be provided for sixty or more children, who will spend about seven hours a day in the tents. Books and furniture will be supplied by the School Board, but the Hartford Society for the Prevention of Tuberculosis will furnish meals and the especially warm clothing that will be needed for such an experiment during the winter.

Dr. Richard Arthur, president of the Immigration League of Australasia, points out in a circular letter that the Government agricultural colleges in Australia offer exceptional advantages in the way of a scientific and practical education in the various forms of agriculture, stock-breeding, dairying, and fruit-growing. He has been able to make arrangements for the reception of students from the United Kingdom at them, and informs us that any lad going to Australia can now be guaranteed entrance at one or other of these institutions. The course is a two-year one, and the fees are exceedingly moderate, ranging from 18*l.* to 30*l.* a year, which sum includes board and lodging.

We learn from *Science* that by the will of the late Mr. John S. Kennedy, banker, of New York City, who died last October in his eightieth year, bequests are made for public purposes amounting to nearly 6,000,000*l.* A bequest of 445,000*l.* is made to Columbia University; another of 300,000*l.* to Robert College, Constantinople; and a bequest of 150,000*l.* to New York University. Gifts of 20,000*l.* are made to the University of Glasgow, Yale University, Amherst College, Williams College, Dartmouth College, Bowdoin College, Hamilton College, the Protestant College at Beirut, the Tuskegee Institute, and Hampden Institute; and of 10,000*l.* to Lafayette College, Oberlin College, Wellesley College, Barnard College (Columbia University), Teachers College (Columbia University), Elmira College, Northfield Seminary, Berea College, Mt. Hermon Boys' School, and Anatolia College, Turkey. Bequests of 5000*l.* are made to Lake Forest University and Center College.

A union has recently been formed by graduates of the University of London to promote the Parliamentary enfranchisement of women on the same terms as men. Since 1878 the University of London has admitted women as candidates for all degrees, honours, and prizes on precisely the same terms as men, and at the present day in all university affairs men and women are accorded the same electoral and other rights, and acquire them through identical qualifications. Graduates of a certain standing are entitled to become members of Convocation, and the register of Convocation would constitute the Parliamentary electoral roll were it not for the condition imposed by Act of Parliament that a Parliamentary voter must be of the male sex. About one-sixth of the members of Convocation are thus deprived of any share in the choice of the representative of their university in Parliament. That such exclusion of an intellectual section of the nation from representation in its councils is contrary to public policy cannot be denied. The university qualification for the vote is a purely intellectual one, and those who do not recognise its sufficiency in the case of one sex would have a difficult task to maintain the right of the other to the privilege attaching to that qualification. All graduates of the University of London—both men and women—who are in sympathy with the objects of the union are urged to join it. Particulars and forms of membership can be obtained from Miss Jessie W. Scott, hon. sec. London Graduates' Union for Woman Suffrage, 114A Harley Street.

The prospects in the matter of the inauguration of a Teachers' Registration Council are much brighter as a result of a conference held on November 13, when representatives of all the important teachers' associations met together, under the presidency of Sir Herbert Cozens-Hardy, Master of the Rolls, to discuss the whole question of registration and to pass resolutions expressing the general feeling of teachers throughout the country. The proposals agreed upon include the establishment of a council on which elementary, secondary, and technical education are represented equally, each by nine representatives, and associations of teachers not included under these three heads by three representatives. Technological education is given a very wide interpretation in the proposed scheme, and includes the work done in technical schools, schools of art, and by teachers of music, of commercial subjects and physical education in its various branches. There were few points on which the meeting had difficulty in coming to practically unanimous conclusions, and armed with the resolutions now adopted the representatives of the conference should have little trouble in convincing the Board of Education that the time has arrived when the provisions included in Education Acts, which long since came into force, for the establishment of a Teachers' Registration Council should be put into force. The work of education is, from the national point of view, of prime importance, and any procedure deserves encouragement which will improve the status of the teaching profession.

Sir John Hewett opened the new laboratories and workshops at Thomason College, Roorkee, at the end of October last, and the address he gave on that occasion is printed in the *Pioneer Mail* of November 5. The speech was the first statement of the general policy accepted by the provincial Government for the development of technical and industrial education. The encouragement of education in applied science was taken up by Sir John Hewett at an early stage of his administration, his first step being the promotion of a technical conference. The proposals of the conference included the provision of industrial and trade schools at important centres and the improvement of the existing industrial school at Lucknow. These were to provide for the lower stages of industrial training. Our contemporary states that this scheme has been adopted by the Government, and is being given effect to as funds are available. Eventually these establishments may be expected to provide a regular supply of trained artisans and mechanics able to adapt themselves readily to western processes. The proposals of the conference referred also to the creation of a technological institute. This institute was to have two branches—at Roorkee and Cawnpore respectively; it was intended that Roorkee should deal only with industries mainly dependent on engineering, while Cawnpore provided for those dependent on chemistry. The proposals allotted 2 lakhs capital expenditure with Rs. 88,000 annually to Roorkee, and 8 lakhs capital with 2½ lakhs annually to Cawnpore. Sir John Hewett said in his speech that the Cawnpore part of the scheme has been deferred, but that a commencement will be made at once with the development of a technological institute at Roorkee. Thomason College is to have the difficult task of working out the lines on which the functions of a technological institute can be carried out in India.

SOCIETIES AND ACADEMIES.

London.

Geological Society, November 3.—Prof. W. J. Sollas, F.R.S., president, in the chair.—S. S. **Buckman**: Certain Jurassic (Lias-Oolite) strata of south Dorset, and their correlation. Descriptions of certain strata (Lower Bathonian to Pliensbachian) on the Dorset coast. Comparison is made with similar strata inland. The strata described are classified according to the scheme introduced for these strata in 1893. The strata are arranged among thirty-six zonal (hemeral) divisions. The Upper Lias part of the junction-bed of Down Cliffs, Chideock, is a very condensed, imperfect epitome in 20 inches of about 80 feet of strata on the Yorkshire coast. Between the *bifrons*-layer and the *striatulus*-layer of the junction-bed there is occasionally a 2-inch layer, which is all that represents some 250 feet of deposit in the Cotteswolds. The Upper Tearcian makes a great showing at Burton Bradstock and Down Cliffs as the Down Cliffs Clay and Bridport Sands. The sequence of *aalensis*-strata above *moorei*-beds is demonstrated at Chideock Quarry Hill, in the upper part of the Bridport Sands. The Inferior Oolite strata of Burton and Chideock are not counterparts of one another; they supplement each other to a certain extent. Mr. Thompson's zonal scheme for the Upper Lias is considered.—S. S. **Buckman**: Certain Jurassic ("Inferior Oolite") Ammonites and Brachiopoda. The paper describes certain species of Ammonites and Brachiopoda which are important for the identification, the correlation, or the dating of Inferior Oolite deposits, and certain other notable species which, having frequently attracted attention in the field, require naming in the interest of future workers.—Dr. W. F. **Hume**: The granite-ridges of Kharga Oasis: intrusive or tectonic? The author quotes the records given by Mr. Beadnell in his paper published in February, 1909, and although in agreement with the facts there stated, differs with regard to the interpretation of those facts. Whereas Mr. Beadnell regards the granite as intrusive, on account of the high dip of the sedimentaries, and the changes which they exhibit as regards colour and hardness, near the granite, the author considers that the dips are due to fold-movements almost at right angles to one another, since they lie on the same line as the crater-like basins, the rims of which are formed of the compact and steeply dipping limestones of the Lower Eocene, and he adduces as further evidence the fact that dykes and quartz-veins penetrating the crystalline rocks cease abruptly at the edge of the sandstone.—Dr. W. F. **Hume**: The Cretaceous and Eocene strata of Egypt. The fossiliferous Cretaceous strata are divided into three series:—(1) A northern Antonian type, marked by Cenomanian species, including typical Turonian strata. (2) A central Egyptian or Hammama type, Cenomanian strata being absent, Campanian marked by abundance of *Ostrea villei* and *Trigonarca multidentata*, and phosphatic beds; the Danian portion having an eastern facies, in which Pecten marls are a characteristic feature, and a western chalky limestone indicating a close affinity with the white chalk of northern Europe. (3) A southern or Dungul type, having close affinities with (2), but in the Campanian the phosphatic beds are inconspicuous, and the fauna consists of a group of specialised sea-urchins and of gastropods, among which Turritellæ are very prominent. The uniformity of the Lower Eocene throughout Egypt is emphasised, its triple subdivision being recognisable over vast areas. In the Middle Eocene this uniformity is replaced by differentiation. Five zones have been recognised in the lower division, while in the Upper Moqattam the Turritella-beds and the strata rich in *Carolia placunoides* and *Plicatula polymorpha* are of zonal importance. The Lower Moqattam is considered as beginning with the *Nummulites gizehensis* zone and closing with the Gistortia-bed. The relation between the Cretaceous and Eocene beds is discussed. Palæontologically, great groups such as the Ammonites, still abundant in the Upper Cretaceous, disappear in the Eocene, and are replaced by the characteristic nummulinid Foraminifera. Both periods bear a resemblance to each other in the dominance of oysters and sea-urchins. A notable feature is the rarity of Brachiopoda in Egypt throughout both periods, nor have belemnites been recorded from the Egyptian Cretaceous. Among post-Eocene formations the calcareous grits are shown to have a wide extension, but in the desert they differ in character from the mammal-yielding beds of the Fayûm. The Cretaceous period in Egypt was one, in the main, marked by the gain of sea over land, the Eocene was one of rest, while at the close of the Eocene and during the Oligocene the approach of a continental phase is clearly indicated.

Linnean Society, November 4.—Dr. D. H. Scott, F.R.S., president, in the chair.—Cecil **Carus-Wilson**: Natural inclusion of stones in woody tissue. About twenty-three years ago a gravel-pit was started in the valley-gravels occurring some three miles from Faversham, in Kent. Part of a wood covered the deposit; as the work progressed oak trees were felled, and the stumps and roots dislodged. The gravel consists of subangular, water-worn flints and occasional blocks of Sarsen-stone, the whole being mixed with flint grit and quartzose sand. The roots and stumps were distributed as the gravel in which they were embedded was removed. The work of excavating ceased about ten years ago, so the roots still remaining have been exposed for that length of time, the others having been cut up for fuel. Most of those now found were left intact because of the stones enclosed in the wood. Not only did these resist the work of saw and axe, but when burnt they burst asunder with force, becoming a source of danger. The stones are actually embedded in the solid oak. The tissue of the wood appears to have grown around the stones and enveloped them, indicating that the process was carried on under conditions of pressure. There are dozens of stones embedded in some of these roots, so that the substance may be described as "a conglomerate formed of flints enclosed in a woody matrix." In one specimen no fewer than sixty-seven flints were counted, the largest being several pounds in weight, and there are innumerable empty cavities showing where others existed before the shrinkage of the wood after exposure. Odd stones have been occasionally seen thus embedded in the trunks of trees. In Norton Churchyard, a few miles from Faversham, are three old yew trees, and in two of them flints and fragments of tiles have been seen embedded in the wood of the trunk 7 feet above the ground. In Molash Churchyard, six or seven miles south of Faversham, there are six very old and large yews. Some of these have flints embedded in their trunks 7 feet or 8 feet above the ground. The examples first described are unique, and if trees can enclose stones in such quantities, and retain them within their substance so tenaciously, we have transporting agents capable, under certain conditions, of distributing terrigenous material over sea-beds to an extent not hitherto appreciated.—Dr. A. B. **Rendle**: Specimen of heather (*Erica cinerea*) found near Axminster in which the flowers were replaced by dark red leaf-buds of about the same size as the flowers. The red leaf-buds, which occupy the position of flowers, consist each of short, strongly ascending leaves arranged in superposed whorls of four; the four lines have often a spiral twist in the upper part of the bud. The leaf-arrangement resembles that of the flower, not of the foliage leaves. The leaves of these special buds differ in form from the foliage leaves in that they are upwardly concave with a bluntly keeled back. They are thirty-two or more in number, and thus considerably outnumber the parts of a typical flower (twenty-four, including bracteoles). The tip of the bud was always damaged, but in many a shrivelled pistil was present, and sometimes below this semi-foliaceous stamens were found. The specimen is of interest as resembling a teratological form of *Erica cinerea* described by Maxime Cornu in 1879.—Prof. H. H. W. **Pearson**: Types of the vegetation of Bushmanland, Namaqualand, Damaraland, and South Angola (a preliminary report of the Percy Sladen Memorial Expedition in South-west Africa, 1908–9). The floras of the regions named in the title are distinctly related if the vegetation found on the Huilla plateau in South Angola be excluded. Otherwise the differences that are observed are to be accounted for mainly as a result of differences of (1) elevation; (2) atmospheric humidity; (3) depth at which permanent supplies of underground water are available; (4) geographical position. In all the rainfall is scanty and inconstant, and there is a prolonged drought in the winter season. Near the coast, in some places up to elevations as great as 2700 feet, the total annual rainfall is never more than a few millimetres, and frequently fails altogether. The affinities of these floras are with those of the South Central African highlands. In South Angola many species are derived undoubtedly from the coast and Montane regions of West Tropical Africa. Throughout, the vegetation is xerophytic in character, and is marked either by a short period of duration or by the possession of those structural peculiarities which are found in dry climate perennials. Of these, hairiness is not a conspicuous feature; except in Lower Namaqualand, succulence is not common. A round, bushy habit is marked throughout. The root system is deep; the leaves are simple and of small size, and with a strongly developed cuticle. The formations and associations indicated are predominant by reason either of their great extent or of striking peculiarities of the plants composing them. They are arranged in the main geographically from south to north.

Zoological Society, November 9.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—Sir H. H. **Howorth**: Some living shells, their recent biology, and the light they throw on the latest physical changes in the earth, i., *Mya arenaria*. The author stated that the *Mya arenaria* or clam is widely distributed in the North Boreal, European, and North American seas, and claimed to prove that it is a recent migrant into the former, and has probably not been there more than 300 years. The notion that it is an Arctic shell is a mistake. In the Arctic lists *Mya truncata*, var. *oblonga*, has been mistaken for it, and the glacial character of the beds in which it has occurred, which has been postulated from its occurrence there, has accordingly been a wrong inference. Brögger has argued that it migrated from America. It was abundant in the Crag seas, and occurs in derivative fragments in the Drift-beds, but it does not occur in the estuarine deposits or raised beaches, proving that after the period of the Crag it became extinct in Europe, and has since been re-introduced. He regarded the cause of its extinction as a mystery, since the group of estuarine shells with which it is found has lived continuously in Europe since later Crag times.—C. Tate **Regan**: The Asiatic fishes of the family Anabantidæ (including the Osphromenidæ). The author remarked that the order Labyrinthici was an isolated and terminal group, probably derived from a cyprinodontoid stock, and that it comprised two suborders, Ophiocephaloidei and Anabantoidei, the latter including the families Anabantidæ and Luciocephalidæ. The Indian element in the fresh-water fish-fauna of Celebes, including two labyrinthic fishes, was shown to consist of (1) species which had travelled by sea, and (2) species which had probably been introduced by man. The great importance of Wallace's line for fresh-water fishes was thus vindicated. The Asiatic genera and species of Anabantidæ were described, including several new forms of Betta and Trichopodus, and the Asiatic genus Anabas was shown to differ markedly from the African Ctenopoma and Spirobranchus.—J. Lewis **Bonhote**: Some mammals brought home from Egypt. The paper dealt with about twenty-eight species, chiefly small rodents, and the main points of interest were the recognition of *Procavia burtoni*, the Egyptian hyrax, as a valid species, the re-discovery of *Acomys russatus*, hitherto only known from Palestine, and the description of a small species of Dipodillus, the last two species having been taken on the Mokattam Hills within three miles of Cairo.

Mathematical Society, November 11.—Sir W. D. Niven, president, in the chair.—G. H. **Hardy**: (1) The ordinal relations of the terms of a convergent sequence; (2) the application to Dirichlet's series of Borel's exponential method of summation; (3) theorems relating to the summability and convergence of slowly oscillating series.—Prof. W. **Esson**: Notes on synthetic geometry.—H. **Bateman**: Kummer's quartic surface as a wave surface.—Prof. H. S. **Carslaw**: The Green's function in a wedge and other problems in the conduction of heat.—J. L. S. **Hatton**: The envelope of a line cut harmonically by two conics.—Rev. F. H. **Jackson**: A class of q-hypergeometric series.—Informal communications were made as follows:—Dr. E. W. **Hobson**: An extension of Abel's theorem concerning the sums of series at points on the circle of convergence to oscillatory series.—Prof. A. E. H. **Love**: The effect of the earth's rotation upon the observed values of the lunar disturbance of gravity.

Cambridge.

Philosophical Society, October 25.—Dr. Hobson, vice-president, in the chair.—A. A. **Robb**: Discussion of a difference equation relating to the tension of overhead wires supported by equidistant poles.—F. G. **Sinclair**: Note on the abnormal pair of appendages in Lithobius.—J. E. **Littlewood**: A class of integral functions.—J. A. **Crowther**: The scattering of the β rays from radium by air.—R. **Whiddington**: Note on the electrical behaviour of fluorescing iodine vapour. The note describes an experiment showing that iodine vapour is un-ionised when brilliantly fluorescing under the action of the arc light.—Rev. H. J. **Sharpe**: The reflection of sound at a paraboloid.—G. W. C. **Kaye**: The emission of Röntgen rays from thin metallic sheets. Thin metal leaf antikathodes were subjected to bombardment by kathode rays, and the (emergent) X-rays proceeding from the remote side of the leaf were compared with those which left on the near side (incident). In general, the emergent Röntgen radiation in such cases exceeds the incident in intensity, markedly so in the case of aluminium. The ratio of the emergent intensity to the incident increases with the speed of the kathode rays employed. As the thickness of the metal leaf is increased, the emergent intensity increases to a maximum and then dies away, the incident intensity meanwhile gradually increasing to a constant value.—F. **Horton**: The emission of positive rays from heated phosphorus compounds.

November 8.—Prof. Bateson, F.R.S., president, in the chair.—N. R. **Campbell**: Discontinuities in light emission. An account is given of an attempt to test the theories of Sir J. J. Thomson and of Planck as to the atomic nature of radiation by means of observations on the fluctuations in the intensity of a source of light. The experiments are similar in nature to those of Meyer and Regener, based on the theory of von Schweidler, on the fluctuations of an ionisation current due to the α rays of radium. The theory and the methods of the experiments are discussed at length, and also the nature and cause of an unexpected difficulty which has prevented, up to the present time, the attainment of definite results; but it is hoped that such results may be reached in the near future.—J. A. **Orange**: The shape of beams of canal rays. An appendix to a paper previously communicated to the society. In that paper it was suggested that the component rays in a beam of canal rays are straight, the curved boundaries of the beam being envelopes merely. This appendix describes one or two simple experiments which support that view.—H. **Bateman**: The determination of solutions of the equation of wave motion which involve an arbitrary function of three variables which satisfies a partial differential equation.—H. J. **Priestley**: The oscillations of superposed fluids.—L. B. **Turner**: The stresses in a thick hollow cylinder subjected to internal pressure.—Sir J. J. **Thomson**: The theory of the motion of a charged particle through a gas. It is pointed out in this paper that, in consequence of the "persistence of velocities," which is especially marked when the mass of an ion is much greater than that of a molecule of the gas through which the ion is moving, methods founded on the conception of the free path are not suited for the calculation of the velocities of the ions. If we suppose that the operative forces acting between the ions are such as exist between a charged body and a conducting sphere, the force between the ions and the molecules would, except close to the molecules, be proportional to the inverse fifth power of the distance, and we can apply Maxwell's results to this case, making the slight alterations which are necessary when the force is an attraction instead of a repulsion, as in Maxwell's investigation. The expressions deduced in this way for the mobility are such that, considered as a function of M, the mass of the ion, and m, the mass of a molecule of the gas, the mobility varies as $\left\{\frac{M+m}{M}\right\}^{\frac{1}{2}}$, and thus, when M is large compared with m, varies very slowly with the mass of the ion. The diffusion of the emanations of radioactive substances through air or other gases would, since the molecules of the emanation carry electrical charges, follow the same law, so that the rate of diffusion of the emanation would only vary very slowly with the atomic weight; thus we cannot attach much importance to determinations of the atomic weight of the emanation made by observing their rate of diffusion through other gases.

MANCHESTER.

Literary and Philosophical Society, November 2.—Mr. Francis Jones, president, in the chair.—T. G. B. **Osborn**: A note on the staminal mechanism of *Passiflora coerulea*. The paper contained a record of observations made during the summer of this year on *Passiflora coerulea*, and directed attention to three staminal movements which occur in the order in which they are given below, viz.:—(1) A radial movement of the anthers on the filament of 180°, which occurs as soon as the flower opens. (2) A second movement of the anther through 90° into a plane at right angles to the first, *i.e.* into the tangential plane, in which position a special mechanism is called into play to retain it there. (3) The radial movement, in two stages, of the stamen as a whole, so as to bring it from an erect to a drooping position, the first stage of this movement being in part concurrent with (2), and coextensive with the first stage of anthesis.—D. M. S. **Watson**: A preliminary note on two new genera of Upper Liassic Plesiosaurs. The Manchester Museum contains two important skeletons of *Plesiosaurus homalospondylus*, Owen, which show that the pectoral girdle does not conform to the type of that of Plesiosaurus, but is elasmosaurian, resembling that of Cryptocleidus. The coracoids are narrow; the scapulæ meet in the middle line and pass back as a bar to join the coracoids. The clavicular arch is reduced, lying on the visceral surface of the anterior plates of the scapulæ. There is no interclavicle. A new genus, Microcleidus, is founded for the species. Another skeleton, lacking the head, also in the Manchester Museum, is made the type of the new genus and species *Sthenarosaurus dawkinsi*. The genus is remarkable for the smallness of the coracoids and the strong clavicular arch, which resembles that of Thaumatosaurus, as determined by Lydekker, but has a posterior process in the centre.

November 16.—Mr. Francis Jones, president, in the chair.—C. E. **Stromeyer**: Relative periods of revolution of planets and satellites. The author pointed out that, if the solar system has been built up out of meteorites, certain relations as regards periods of revolution should exist both amongst the planets and their satellites. The periods, not only of the planets, but also of their satellites, should be expected to stand in the ratios 1, 2, 4, 8, &c., or 1, 3/2, 2, 3, 4, &c. The first of these series is well represented by Jupiter's satellites, I., II., and III. of which stand in the exact ratio of 4, 8, 16; V. has a period of 1·1, IV. has a period of 37·8 instead of 32, and VI. and VII. combined have a period of 576, or little more than 512, which would be the tenth term of the series. The outermost satellite, the exact period of which has not yet been determined, should, if the above rule holds good, have a period of twice 260 days, say one and a half years. Saturn's satellites agree with the second series, which includes thirds. The mean periods of the several pairs are 1, 2, 3·96, —, 16·5, —, 68·1.—F. **Nicholson**: Some early correspondence between Mrs. Hemans and Mr. Matthew Nicholson, a former member of the society.

PARIS.

Academy of Sciences, November 15.—M. Bouchard in the chair.—G. **Darboux**: Congruences of curves.—M. **Gouy**: The vapour pressure of an electrified liquid. The total effect, at least for liquids having a high specific inductive capacity, is for an electric field to increase the vapour pressure. The dielectric polarisation, when the field is normal to the surface, produces an increase in the vapour pressure; the increase of the ions in the surface layer of the electrolyte diminishes the vapour pressure, and the net result is the difference of these two effects.—M. **de Forcrand**: The acid carbonates of the alkalies.—Édouard **Heckel**: The influence of anæsthetics and frost on plants containing coumarin. Plasmolysis is produced by the action of chloroform, ether, or by cold, the coumarin being immediately given off.—Édouard **Heckel**: Fixation of the cultural bud-formation of *Solanum maglia*.—M. **Idrac**: Ocular and photographic observations of the planet Mars. An account of observations made at the Meudon Observatory with the large double telescope during the recent opposition of Mars. In some instances details were shown on the photographs which could not be observed by simultaneous eye observations.—E. M. **Antoniadi**: Observations of the planet Mars made at the Observatory of Meudon. A map of the planet, on Mercator's projection, is given, summarising observations made between September 20 and November 9.—A. de la Baume **Pluvinel** and F. **Baldet**: The photography of the planet Mars. An account of work done with the new equatorial at the astronomical station on the Pic du Midi.—N. E. **Norlund**: Equations of finite differences.—G. A. **Miller**: Groups produced by two operators, each of which transforms the square of the other into its inverse.—Albert **Grumbach**: Contact electrification. A study of the electromotive forces produced by the filtration of solutions of potassium chloride, with and without an added non-electrolyte (phenol).—Vasilesco **Karpen**: Telephony at great distances.—André **Léaute**: The destructive effects of oscillating discharges of high frequency.—Gargam **de Moncetz**: A formula for sensitising plates for the extreme red, commencing with the infra-red. The solutions given, used on silver iodobromide plates, enable lines up to the calcium line λ 860 to be photographed.—Paul **Gaubert**: A new highly fluorescent substance derived from physostigmine. Physostigmine in aqueous solution is allowed to stand for several months until it has acquired a deep blue colour, and to this phthalic acid is added. The substance produced forms deep blue crystals, which in solution are intensely fluorescent.—W. **Broniewski**: The electrical properties of the aluminium-copper alloys. Twenty alloys of aluminium and copper were prepared. The measurements made on these included the electrical conductivity at 0° C., the temperature coefficient of the resistance, the electromotive force against carbon in a solution of ammonium chloride, and the thermoelectric power. The results are given both in tabular and graphical form. In addition to the definite compounds of aluminium and copper already known, the existence of Al_2Cu_3 has been brought out by these experiments.—Georges **Meslin**: The magnetic properties of liquids constituted by siderose. Aniline or carbon bisulphide containing powdered siderose in suspension exhibit the phenomenon of magnetic dichroïsm to an extent much greater than with any substances previously examined.—Abel **Buguet**: The cryoscopy of organic mixtures and addition compounds. An account of the cryoscopic study of mixtures of acenaphthene and phenanthrene with two nitrotoluenes.—H. **Baubigny**: The action of heat and light on silver sulphite and the double alkaline sulphites. The determination of the yield of dithionic acid.—V. **Auger**: The mixed halogen stannic compounds. The bromiodide $SnBr_2I_2$ was submitted to a series of slow crystallisations, and the ratio of iodine to bromine found to vary. The study of the cooling curve of the supposed $SnBr_2I_2$ showed that this also behaved as a mixture.—P. J. **Tarbouriech**: The dehydration of oxycyclohexyldimethylcarbinol.—M. **Deprat**: The eruptive and metamorphic formations of Tonkin, and on the frequency of laminated types.—F. **Grandjean**: The optical study of the absorption of heavy vapours by certain zeolites. The substances absorbed by the crystal of zeolite affect the optical properties of the crystal to a marked extent. The optical properties found are never intermediary between those of the crystal and those of the body absorbed.—Fernand **Guéguen**: The existence of sclerotes in *Mucor sphaerosporus*.—R. **Anthony** and W. B. **Pietkiewicz**: New experiments on the *rôle* of crotaphytic muscle (temporal) on the morphological constitution of the skull and face.—Louis **Lapicque**: The theory of electrical stimulation: a hydraulic analogy.—M. **Baudran**: Artificial media capable of attenuating or strengthening the virulence of Koch's bacillus. The formulæ of the two media differ only in the use of iron in the one and manganese in the other. The one containing iron causes a marked attenuation in the virulence of the bacilli grown in it; the replacement of the iron by manganese, on the other hand, has the exactly contrary effect.—MM. **Trillat** and **Sauton**: The action of putrid gases on micro-organisms. The putrid gases arising from the decomposition of animal extracts were allowed to act on yeast, parallel cultures of the same yeast without the addition of such gases being made at the same time. The effect on the yeast was measured by the alcohol produced. Both increases and decreases in the fermentative action were observed, the effect depending on the proportion of gas present.—Alfred **Angot**: The earthquake of November 10, 1909. Details of the traces of the seismographs at Parc Saint-Maur Observatory. The epicentre was calculated to be at a distance of 8700 kilometres.—M. **Audouin**: Observations made in the course of the Tilho expedition. —M. **de Beauchamp**: The working of the apparatus for the protection of the Vienne district against hail and thunderstorms during the year 1909. The protection during the year has been very satisfactory, and the system is to be further extended.—A. **Gruvel**: *Résumé* of some scientific observations made on the coasts of Mauritania (N. Africa) from 1905 to 1909.

DIARY OF SOCIETIES.

THURSDAY, November 25.

Royal Society, at 4.30.—On the Change in Hue of Spectrum Colours by Dilution with White Light: Sir William de W. Abney, K.C.B., F.R.S.—On the Nature of the Hydrogen Flocculi and their Structure at Different Levels in the Solar Atmosphere: Prof. G. E. Hale, For.Mem.R.S., and F. Ellerman.—The Boiling Point of Sulphur corrected by Reference to New Observations on the Absolute Expansion of Mercury: Prof. H. L. Callendar, F.R.S., and H. Moss.—(1) On the Refraction and Dispersion of Neon; (2) On the Refraction and Dispersion of Air, Oxygen, Hydrogen, and Nitrogen; (3) On the Refraction and Dispersion of Sulphur Dioxide and Hydrogen Sulphide, and their Relation to those of their Constituents: C. Cuthbertson and M. Cuthbertson.—On Flapping Flight: Prof. M. F. Fitzgerald.—The Crystalline Structure of Iron at High Temperatures: W. Rosenhain and J. C. W. Humfrey.—The Relation of Thallium to the Alkali Metals: a Study of Thallium-zinc Sulphate and Selenate: Dr. A. E. H. Tutton, F.R.S.—On the Nature of the Diffraction Figures due to the Heliometer: P. F. Everitt.—The Motional Effects of the Maxwell Æther-Stress: E. Cunningham.—The Aberrations of a Symmetrical Optical Instrument: Dr. H. C. Pocklington, F.R.S.—The Spectrum of Radium Emanation: H. E. Watson.—The Electric Conductivity and Density of Solutions of Hydrogen Fluoride: Prof. E. G. Hill and Dr. A. P. Sirkar.—Sleeping Sickness in Uganda. Duration of the Infectivity of the *Glossina palpalis* after the Removal of the Lake-shore Population: Colonel Sir David Bruce, C.B., F.R.S., Captains A. E. Hamerton and H. R. Bateman, R.A.M.C., and Captain F. P. Mackie, I.M.S.

Institution of Electrical Engineers, at 8.—The Present Aspects of Electric Lighting: H. W. Handcock and A. H. Dykes.

FRIDAY, November 26.

Physical Society, at 5.—The Effective Resistance and Inductance of a Helical Coil: Dr. J. W. Nicholson.—Ductile Materials under Combined Stress: W. A. Scoble.—The Recoil of Radium C from Radium B: Dr. W. Makower and Dr. Sidney Russ.—The Sun's Motion with Respect to the Æther: Dr. C. V. Burton.

MONDAY, November 29.

Royal Society of Arts, at 8.—Aëronautics: C. C. Turner.

Institute of Actuaries, at 5.—American Railway Securities as Investments for Insurance Companies: H. Ansell.

TUESDAY, November 30.

Royal Society of Arts, at 4.30.—Agricultural Development in Nyasaland: S. Simpson.

Royal Anthropological Institute, at 8.15.—The Pit Dwellings at Holderness: Canon Greenwell, F.R.S., and Rev. R. A. Gatty.

Faraday Society, at 8.—On the Electro-analytical Determination of Lead as Peroxide: Dr. H. J. S. Sand.—The Calorimetrical Analysis of Hydrated Salt: Prof. F. G. Donnan and Dr. G. D. Hope.—(1) On the Influence of Dissolved Gases on the Electrode Potential in the System Silver-Silver Acetate, aq.; (2) Contributions to the Study of Ionisation in Aqueous Solutions of Lead Acetate and Cadmium Acetate: A. Jacques.

Institution of Civil Engineers, at 8.—*Further discussion*: The Single-phase Electrification of the Heysham, Morecambe and Lancaster Branch of the Midland Railway: J. Dalziel and J. Sayers.—The Equipment and Working-results of the Mersey Railway under Steam and under Electric Traction: J. Shaw.—The Effect of Electrical Operation on the Permanent-way Maintenance of Railways, as Illustrated on the Tynemouth Branches of the North-Eastern Railway: Dr. C. A. Harrison.

WEDNESDAY, December 1.

Royal Society of Arts, at 8.—Improvements in Resilient Wheels for Vehicles: Hon. R. C. Parsons.

Society of Public Analysts, at 8.—The Composition of Cream: R. R. Tatlock and R. T. Thomson.—Analyses of Vulcanised Rubber Goods: Clayton Beadle and Henry P. Stevens.—On the Gravimetric Estimation of Nickel in Nickel Steel: E. L. Rhead.—Notes on the Milk Supply of Two Large Towns: F. W. F. Arnaud and Edward Russell.

Geological Society, at 8.—The Tremadoc Slates and Associated Rocks of South-east Carnarvonshire: W. G. Fearnsides.—On some Small Trilobites from the Cambrian Rocks of Comley, Shropshire: E. S. Cobbold.—(1) The Rock of Pulau Ubin and Pulau Nanas, Singapore; (2) The Tourmaline-Corundum Rocks of Kinta, Federated Malay States: J. B. Scrivenor.

Entomological Society, at 8.—Discussion on *Agriades coridon* and *A. thetis* (*bellargus*), opened by Mr. J. W. Tutt.

THURSDAY, December 2.

Royal Society, at 4.30.

Röntgen Society, at 8.15.—Some Effects of Electrical Discharges on Photographic Plates: Prof. A. W. Porter.

Linnean Society, at 8.—Nudibranchs from the Indian Ocean: Sir Chas. Eliot, K.C.M.G.—Trichoptera von Mr. Hugh Scott, auf den Seychellen gesammelt: Dr. Georg Ulmer.—Report on the Brachiopoda obtained from the Indian Ocean by the *Sealark* Expedition, 1905: Dr. W. H. Dall.—Narrative of the *Sealark* Expedition, Part III.: Prof. J. Stanley Gardiner, F.R.S., and others.

FRIDAY, December 3.

Institution of Civil Engineers, at 8.—The Design of Generating Stations: G. Ingram.

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THURSDAY, DECEMBER 2, 1909.

JOHN DEE.

John Dee (1527–1608). By Charlotte Fell Smith. Pp. xvi+342. (London: Constable and Co., Ltd., 1909.) Price 10*s*. 6*d*. net.

IN the personal history of learning there is probably no more interesting or more perplexing figure than the subject of this book. The story of John Dee reads more like a romance by Sue or a *feuilleton* by the elder Dumas than as a sober, veracious narrative of an actual human career. The achievements of the man, his learning, the range of his knowledge, his aberrations, his vicissitudes of good and evil fortune—mainly evil—taken together, make up a tale which has hardly a parallel in biographical literature, certainly not in the biography of science.

There is a time-honoured adage that a man is to be judged by the company he keeps. John Dee certainly mixed in very questionable company during one period of his extraordinary career, and his memory has greatly suffered from that circumstance. Although he enjoyed the patronage, and to some extent the protection, of the great—mainly from motives of self-interest—his contemporaries for the most part looked askance at his performances, and his life in consequence became a continuous and prolonged struggle with prejudice, misrepresentation, and slander.

Miss Fell Smith may be congratulated unreservedly on her work. Even in this age, which has witnessed many attempts to reverse the adverse judgment of a man's fellows, it needed some courage to try to rehabilitate John Dee in the good opinion of posterity. But, by treating her subject in the spirit of science, that is, by patiently investigating the facts, carefully sifting and weighing the evidence, and skilfully unravelling the tangled web of truth and fiction which has hitherto enveloped his history, his latest biographer has for the first time succeeded in laying bare his true character, and in revealing the hidden springs and motives of his actions. In the record she has put together, Miss Fell Smith has elaborated her testimony and presented the case for the panel, as the Scotch say, with no ordinary literary ability, and the dispassionate reader must admit that she has succeeded in clearing the old philosopher's memory from the charges of deceit, dissimulation, and knavery which lay heavy on it.

In reality, John Dee was a man born out of due season. His age was not ready for him. In the times of the Tudors there was no place in the body politic for the professed man of science, unless he practised his science covertly as a physician or a priest. Even then its pursuit was attended with a considerable measure of personal peril. John Dee, it is true, dabbled in medicine, as he dabbled in most things that had any connection with the science of his period, and he was thereby of occasional service to his suffering fellows. For a time, too, his only means of subsistence came from a couple of wretchedly endowed country livings to which he was presented. But he was never recognised as a practising physician, or as a professed priest. His life's work was the pursuit of truth merely for the sake of elucidating it, an occupation unintelligible to his age. Apparently every aspect or form of truth was of equal importance to him; but, naturally enough, the direction in which he searched was influenced by his environment and the circumstances of his time. It was inevitable that such a man should sooner or later come into conflict with his age—a hard, unrelenting, pitiless age; and it was equally inevitable that he should be worsted in the fight. The spectacle of a strong man struggling with adversity is, we are told, a sight loved by the gods. We cannot help thinking that it is the spectacle of a sorely tried albeit misguided man, bent and well-nigh broken by the storms of fate, that has touched and quickened the womanly sympathy of the author of this book. Its compilation has evidently been a labour of love, or of the pity which is akin to it. Every page bears testimony to the patient care and trained skill with which the author has searched all available records and followed every clue which might serve to unravel the mystery of her hero's life.

John Dee was born in London in 1527. His father, Rowland Dee, was a gentleman server in the court of Henry VIII. The boy was sent to the Chantry School at Chelmsford, and thereafter, at the age of fifteen, to St. John's College, Cambridge, where he graduated in 1546, and was made a fellow of Trinity at its foundation by Henry VIII. Two years later, after taking his M.A. degree, he entered the University of Louvain, and thence passed on to Paris, where he gave lectures at the university on Euclid. Returning to England, he produced one or two astronomical works, and a book on the cause of the tides, presumably for the use of Edward VI. On the accession of Mary he got into trouble, and was thrown into prison on a charge of magic, and eventually of treason, and stood his trial by the Star Chamber. Nothing could be proved against him, and he was liberated, only to be handed over to the tender mercies of Bishop Bonner. He escaped even this ordeal, and subsequently presented Mary with a project for the establishment of a great national library in which to preserve "the treasure of all antiquity," the priceless collections of ancient literature which had been scattered by the dissolution of the monasteries and religious houses. Nothing came of the suggestion at the time. A couple of centuries had to elapse before the British Museum was founded, and it was only in the opening years of Queen Victoria's reign that keepers of the public records were appointed and the Historical Manuscripts Commission was brought into existence.

Easier times came to Dee with the advent of Elizabeth. He was already well known to her. She had corresponded with him when confined to Woodstock. His position as a mathematician had been established, and the name of the editor of Billingsley's "Euclid" was known throughout the learned world. The friend of Mercator—"my Gerard," as he calls him—he was esteemed, too, as a geographer skilled in cartography, and was constantly consulted by the great sea-captains of his time—Gilbert, Davis, Frobisher, Hawkins, Cavendish, and others of the remarkable band that created the sea-power of England. Dee had settled at Mortlake, where he was frequently visited by the Queen. Elizabeth had ever an eye for a comely man, and Dee was remarkably handsome, tall, stately, and of a dignified mien. The picture which Miss Fell Smith draws of his home life there, with his second wife—"his paynful Jane," as he calls her, the staunchest, truest friend he ever had—with the great Queen, either when "taking the ayre" or when on her way from Hampton Court or Isleworth to her palace at Greenwich, cantering up to his garden gate in order to get sight and speech of her courtly philosopher, is a charming piece of word-painting. But these were not altogether halcyon days for Dee. Elizabeth was gracious, even profuse in promise, but she was a very niggard in performance, and her astrologer was occasionally hard put to for the means of living.

Edward Kelley—*alias* Talbot—clipper, coiner, forger, and thief, now appears upon the scene, and the aspect of things becomes very grim. This man was Dee's evil genius. Their connection is one of the most astonishing and perplexing circumstances of his history. How Kelley could have acquired such complete ascendancy over his patron is almost inexplicable. Kelley was a first-class ne'er-do-well, a lover of loose company and of strong waters, and a consummate liar. He professed to be a clairvoyant, a skryer, or crystal-gazer, and Dee's passion for occultism was such that no tale of mystery or message from the spirit world was too gross or outrageous for him to swallow, as his own records of their *séances* demonstrate. Dee was an operative alchemist of no mean reputation, and the supposition is that Kelley sought to worm himself into Dee's confidence in order to gain information concerning the manufacture of the philosopher's stone, about which Dee never professed any knowledge. It is impossible here to go into any detail of the extraordinary partnership into which the pair entered, or to tell how they were induced, mainly at the instigation of a Polish adventurer, to wander, with their wives and Dee's children, on to the Continent, through Holland, North Germany, Poland, and eventually to Prague, where Kelley took service under Rudolph II., the "Hermes of Germany."

The story of that morose, half-witted, loose-living fanatic, who secluded himself for years in his gloomy palace at Prague, occupying himself with astrology, thaumaturgy, alchemy, necromancy, and every other form of aberration of which the human mind was then capable, is one of the most striking chapters in the book. Here Kelley was in a congenial atmosphere; he became wealthy—how is not very clear—flourished, in fact, like the bay tree, and was ennobled, only to fall more rapidly than he rose. He had previously shaken off Dee; he had no further use for him. The poverty-stricken, disillusioned man, after six years' wandering over Europe, now set his face once more towards Mortlake, only to find that, in his absence, his precious library of 4000 volumes had been rifled, and his instruments and apparatus broken by his neighbours. Well might he exclaim:—

"Have I so long, so dearly, so farre, so carefully, so painfully, so dangerously, fought and travailed for the learning of wisedome and atteyning of vertue, and in the end am I become worse than when I began? Call you this to be learned? Call you this to be a philosopher and a lover of wisdome?"

Could anything be more dramatic? The peaceful home on the banks of the Thames, into whose "silver" stream Dee's children occasionally tumbled without risk of being poisoned by the filth of Brentford; the surprise visits of the Queen; the advent of Kelley, and with him all the ghastly, skrying, crystal-gazing business—just as it is done to-day in Bond Street—communings with Annael, Anachor, Anilos, Uriel the Spirit of Light, Bobogel, Michael with his fiery sword, Gabriel, Raphael, Il, Ave, and the rest. Then comes Madimi, the first of the female angels who appeared to the pair, sometimes as "a pretty girl of seven or nine years attired in a gown of Sey, changeable green and red, with a train," and at other times as "a wench in white," and who had learned Greek, Arabic, and Syrian on purpose to be useful. Next enters the Mephisto of the story—Laski, the Polish adventurer, introduced by an angel named Jubanladec—who enjoined him to "live better and see himself inwardly." At his solicitation the pair decide to go with him to Poland. Then comes the journey across Holland, and along the devious peat-coloured waterways of East Friesland and out to sea by the islands up to Embden, and so to Oldenburg, Bremen, and Lubeck. Thence to Cracow, and eventually to Prague, where we have the mad Emperor, and all the diabolical doings in chicanery and fraud which bring the cropped-eared Kelley to his end. Lastly, we have the return of Dee—a ruined man, cheated by those he trusted, shunned by his acquaintance, scorned by his enemies—to the wrecked house at Mortlake he called home.

What a phantasmal tragedy it all seems! And yet it is sober history, capable of being verified in detail, as Miss Fell Smith demonstrates in her vivid, scholarly, and deeply interesting narrative.

T. E. THORPE.

THE PRECIOUS METALS.

The Precious Metals, comprising Gold, Silver, and Platinum. By Dr. T. Kirke Rose. Pp. xvi+295. (London: A. Constable and Co., Ltd., 1909.) Price 6*s*. net.

DR. ROSE, as is well known, is the author of the chief text-book on the metallurgy of gold; a book on the "Precious Metals" from his pen is, therefore, most welcome, and although in dealing with this subject details of processes and methods are for the most part left out, yet nothing of importance as introductory to the study of these metals is omitted.

The author states in the preface that his aim "has been to provide an introduction to the study of the precious metals and an elementary book of reference for those who do not wish to pursue the subject further." This aim has been admirably attained.

In the first chapters we have a brief but accurate summary of the history of gold from the earliest times, followed by an account of the properties of the metal and its compounds of special value to the metallurgist. The important subject, the alloys of gold, is treated at greater length in the fourth chapter, which is one of the most valuable parts of the book, and contains an account of these alloys, brief, it is true, but no essential points have been overlooked. The attention of the metallurgical student is especially called to this chapter, as it forms a comprehensive introduction, such as is not found elsewhere, to the detailed study of these interesting mixtures of gold with other metals. The constitution of these alloys, according to modern views, as deduced from freezing-point curves and microstructure, is ably and clearly explained. In the subsequent chapters dealing with gold, the occurrence of the metal in nature and the methods of extracting it from ores are dealt with. Commencing with the simplest and most primitive method of extraction, that of simple "washing" practised from the earliest times and culminating in the modern system of "dredging," the various processes of amalgamation are passed in review, and, finally, the so-called "wet" processes are considered. Of the latter, the cyanide process, to which we owe the extraordinary production of gold in the Transvaal, is dealt with at considerable length in the eighth chapter.

Silver, now of much less importance than gold, since it is no longer in use for the standard coinage of most countries, occupies only about half the space given to the nobler metal.

The alloys, compounds, and ores of silver are first discussed, and then methods of extraction. The important methods are described, and even those which have become, or are becoming, obsolete receive fitting attention. The time-honoured *patio* process in Mexico, where the climate and other conditions were specially favourable for its success, which has produced many millions sterling of the metal, has evidently had its day, is being replaced by the modern cyanide process, and is now mainly of historical interest. The same is true of other "wet" processes in many silver-producing districts.

An entire chapter is devoted to the processes employed in the refining of gold and silver, operations dealing annually with enormous values. Thus gold to the value of 50,000,000*l.* is refined every year by the sulphuric-acid process, 12,000,000*l.* by the chlorine process, and about 4,000,000*l.* by electrolysis.

The chapters on assaying, minting, and the manufacture of gold and silver wares are written with great clearness, and give the best brief and trustworthy account which has yet been published on these subjects. They will be read with interest by both technical and non-technical readers. Platinum, although not usually included in the term "precious metals," yet, being in common use and more valuable weight for weight than gold, has been rightly given a place in the book. The condensed account given of it deals with its occurrence, properties, alloys, extraction, purification, and assay.

The volume concludes with a series of statistics relating to the production and consumption of the precious metals.

The accounts of the various operations by which these metals are extracted from their ores and refined or adapted for minting or industrial use, although brief, are clear and accurate, and the essential points in each process on which its success depends are carefully set forth. A valuable feature, too, is the chemical reactions and changes which occur in the operations, and the principles on which they are based, which appear under each metal.

Dr. Rose is to be congratulated on his book. He has succeeded in compressing within the limits of 295 pages an excellent summary of the metallurgy of gold, silver, and platinum, marvellous in conciseness, quite up-to-date, and without the omission of anything of serious importance.

It deserves many readers, and can be strongly recommended to metallurgical students, by whom it can be studied with advantage before or at the same time as the larger text-books. W. G.

FLOWER CULTURE.

Beautiful Flowers and how to Grow Them. By Horace J. Wright and Walter P. Wright. Pp. 198. (Edinburgh: T. C. and E. C. Jack, n.d.) Published in seventeen parts at 1*s.* each, or two volumes at 10*s.* 6*d.* each.

THIS work will take a high place amongst recent publications dealing with the popular and fascinating art of floriculture. The authors have made a selection of the best and most beautiful flowers for cultivation in the garden and greenhouse. These flowers, numbering 100 in all, are illustrated in full-page coloured plates, which are excellent reproductions of flower paintings by such well-known artists as Beatrice Parsons, Eleanor Fortescue Brickdale, Anna Lea-Merritt, Hugh L. Norris, Lilian Stannard, Margaret Waterfield, A. Fairfax Muckley, and Francis E. James.

Such a collection affords a very valuable guide to amateurs as to which flowers are likely to give them most pleasure, and, in the majority of cases the kinds presented will be found amply sufficient for their study; but, not only so, the plates will prove useful in two further directions. In the first place, many of the pictures depict the particular flowers grouped with other kinds with which they harmonise perfectly in the garden, and, in the second place, as the paintings were in most cases prepared from first-class specimens, they set before the amateur a high standard of culture he will do well to emulate. Both these lessons are given in such plates as a "Bed of La France Roses," "Dwarf and Climbing Roses, with Zonal Geraniums," "Madonna Lily (*Lilium candidum*) and Roses," "Pyrethrums and Lupins," "Foxgloves and Poppies," "Asters, Phloxes and Sweet Peas," "Hippeastrums," "Single Dahlias," "Rosearch and Campanulas," "Hardy Chrysanthemums," and "Water Lilies." In certain others a supremely satisfactory result is obtained by showing a single plant depicted in all its glory, such, for instance, as

"Fibrous-rooted Begonia," in which the peculiar form and colour of a well-flowered plant are clearly set forth; *Lycaste Skinneri, Masdevallia Harryana,* and *Paphiopedilum* (*Cypripedium*) *Curtisii.*

It will be seen that orchids are well represented; indeed, the subjects are selected from almost every class of flowering plant; even the window garden is not forgotten, but, on the contrary, one of the plates illustrates a window-box filled with suitable plants in full flower. It can be said of only a small number that they fail to rank with the best, and in these few cases the original drawings were insufficiently definite in character or the plants depicted were scarcely satisfactory specimens.

So far we have referred only to that portion of the work which answers to the first half of the title, namely, "Beautiful Flowers," but in the text the second half of the title is justified, "How to Grow Them." The authors, being well familiar with their subjects, have related in pleasant, but plain, language all the details of cultivation that are necessary to enable the merest amateur to obtain success. It is satisfactory to note that this is done without the petty gossip and extraneous information that mar so many modern gardening books. In short, the writing, though pleasantly entertaining, is serious, and its main object, namely, that of imparting information, is always kept in mind. Part i. is exclusively devoted to the rose, which is treated at greater length than most of the subjects. Carefully compiled lists of roses specially suitable for particular forms of culture will save the amateur a great amount of research in catalogues, which is seldom satisfactory unless the cultivator has already considerable knowledge of the habits of the different types. Roses are followed by chapters on bulbs, which extend into part iii. Then follows a long article on hardy herbaceous plants, these being amongst the popular flowers of the day.

In part vi. herbaceous plants give place to rockery plants, and these to greenhouse and stove plants. In succeeding parts articles are devoted to sweet peas, carnations, dahlias, chrysanthemums, and all the most beautiful garden flowers, until near the end we come to the floral aristocrats, the orchids. There is a good index, and, in addition to the coloured plates, there are line drawings inserted in the text for the purpose of illustrating some of the cultural processes, such as budding, grafting, and other systems of propagation, also potting, tying, &c. The publishers may be congratulated on the excellent type and the general good appearance of this book, which is suitable for the drawing-room table.

BRITISH CATTLE.

The Evolution of British Cattle and the Fashioning of Breeds. By Prof. James Wilson. Pp. viii + 147. (London: Vinton and Co., Ltd., 1909.) Price 7*s.* 6*d.* net.

THE author of this book exhibits a considerable knowledge of the literature which bears upon the subject of the origin and development of British cattle. His references range from Cæsar's Gallic war to Thomson's recent book on heredity; they embrace not only husbandry in the old and agriculture in the new sense, but political and social history, and such details of the modern sciences of palæontology and Mendelism as are necessary for his purpose. Thus a knowledge of the habits of the peoples dealt with and of the circumstances affecting them at various times is brought to bear upon the problem of the migration of cattle and of the blending of different breeds in olden days, while the evidence he has culled from various writings of the seventeenth and eighteenth centuries is especially noteworthy and valuable to the student of heredity, inasmuch as it throws light on the causes which influenced the establishment of modern breeds during a period of which but little is generally known of stock breeding.

In his opening words the author asserts that it will be his duty to question and sometimes to destroy many fondly cherished beliefs as to the origin, history and evolution of the cattle of these islands. We think he has fulfilled that duty in a clear and convincing manner, and not only so, but has succeeded, as he hoped, in placing before his readers a sounder knowledge of the subject.

After a chapter on *Bos primigenius,* in which he disposes of the evidence advanced to show that this species has ever been represented here, he quotes the work of many modern palæontologists to demonstrate that *Bos longifrons* is the species which was present in the Neolithic age, and was the original native breed. It was this black breed, he says, which was driven with their Celtic owners before the successive invaders of Britain, and remain till this day in Scotland, Ireland, Wales, Cornwall, and the north of England.

He then claims that with the Romans came the white cattle of Southern Europe, from which the wild white cattle found at the time of the Norman invasion and the present wild herds are derived. That with the Anglo-Saxons came the red cattle which dominated the south of England down to the eighteenth century, and of which our Lincolns, Devons, Herefords, Norfolks, Suffolks, and Sussex are the representatives; while with the Norse people came the polled cattle.

After the Norman conquest until the seventeenth century he believes there was but little migration of cattle about the country, and that not until later still was crossing of breeds at all freely carried on. What he calls the "Dutch invasion" of cattle in the seventeenth and eighteenth centuries, caused by England's sympathy with the Netherlands, gave rise to the first shorthorn blood, and, as at this time "landowners had become business men," great impetus was then given to breeding.

He then deals in an admirable manner with the production and evolution of the various breeds which exist to-day; he calls to his aid Mendel's theories, and shows their practical value for the elucidation of such complex problems.

Especially interesting are his chapters on the causes, natural and artificial, which stimulated or checked the spread of the Hereford, longhorn, shorthorn, and Aberdeen Angus breeds; on Bakewell, Charles Colling, Hugh Watson, and other great breeders, and how they all brought their special breeds to perfection, first by their judgment and ability to select good stock, secondly, by judicious inbreeding, and, thirdly, by ruthlessly discarding unsatisfactory animals.

We have no hesitation in recommending this book to all who are theoretically or practically interested in the subject of breeding.

GEOGRAPHICAL MANUALS AND GUIDES.

(1) *A General Geography of the World.* By H. E. Evans. Pp. xii+439. (London: Blackie and Son, Ltd., 1909.) Price 3*s.* 6*d.*

(2) *The Oxford Geographies.* (Oxford: Clarendon Press, 1909.) (*a*) *The Practical Geography.* By J. F. Unstead. Part i, pp. 120; part ii, pp. 112; complete in one volume. Price 2*s.* 6*d.* (*b*) *The Elementary Geography.* By F. D. Herbertson. Vol. i; *A First Physiography.* Pp. 80. Price 10*d.* Vol. iii; *Europe, excluding the British Isles.* Pp. 112. Price 1*s.*

(3) *Cambridge County Geographies. Norfolk.* By W. A. Dutt. Pp. viii+156. *Suffolk.* By W. A. Dutt. Pp. viii+136. *Hertfordshire.* By R. Lydekker. Pp. ix+173. *Wiltshire.* By A. G. Bradley. Pp. xi+156. (Cambridge: University Press, 1909.) Price 1*s.* 6*d.* each.

(4) *By Road and River: a Descriptive Geography of the British Isles.* By E. M. Wilmot-Buxton. Pp. viii+154. (London: Methuen and Co., 1909.) Price 2*s.*

(5) *A Systematic Geography of the British Isles.* By G. W. Webb. Pp. viii+94. (London: Methuen and Co., 1909.) Price 1*s.*

(6) *Highways and Byways in Middlesex.* By W. Jerrold. Pp. xviii+400. (London: Macmillan and Co., Ltd., 1909.) Price 6*s.*

(7) *Growls from Uganda.* By Critolaos. Pp. 120. (London: Elliott Stock, 1909.) Price 2*s.* 6*d.* net.

(1) IF the student of geography can be taught to appreciate the value of a work of general reference, strictly arranged on a systematic plan, Mr. Evans' "General Geography" should meet with a demand. But it is not difficult, on the other hand, to imagine the school-child quailing before these serried ranks of facts, figures, and names, baldly presented, thrust forward by means of heavy-faced type, summarised (where there is need) in tables. It is to be hoped that no attempt is made, in these days, to teach geography out of such a book alone; but as a medium for refreshing the memory on essential points before an examination, it should be of great value. To enhance this value, a number of examination questions are given. Another noteworthy feature is that the index is made to serve as a guide to pronunciation, a matter in which students (and, for the matter of that, most other people) are commonly at fault owing to the difficulty of obtaining guidance in it.

(2) Mr. Unstead's "Practical Geography," as its name suggests, is a guide to practical work in geography. The guidance is provided by series of exercises, each group of which is preceded by an introductory statement. There are two parts in this volume. The first deals with map-reading, field work (*i.e.* the study of local geographical features on the spot), weather, and the British Isles. The second part is for students somewhat more advanced; it deals with map-making, weather changes, and their causes, the form and movements of the earth, the principal countries, and the comparative growth of population and development of commerce in Great Britain and other countries. Full directions are given for plotting on maps or illustrating by diagrams the various classes of geographical information, under the above headings, which are capable of such treatment. The exercises appear to be carefully thought out and suggestive, and ought to interest every student who once acquires an aptitude for them.

It would be hard to keep the requirements of the most elementary teaching more carefully in view than Mrs. Herbertson has in the two volumes of "The Elementary Geography" under notice. There is certainly an art in writing from this point of view. The two volumes are slight, but must needs be so. Simplicity in language and construction of sentences has been strictly adhered to. In this series the extreme value of illustrations has been realised, and some good photographs, selected according to their relevance to points in the text, are provided, with an explanatoin beneath each. A few simple exercises are provided for each subject taken up. These little volumes should supply a real need; their use as an introduction to geography must be manifest, in contrast with volumes of stock questions and answers.

(3) The four volumes of the "Cambridge County Geographies" now under notice are by different hands from those previously commented upon in these columns. While they adhere strictly to the model laid down for the whole series, the style is somewhat less rigid than that of the earlier volumes, and this is undoubtedly an improvement. Line drawings have not been used in the present volumes, and the photographs call for particular commendation as being well chosen and well reproduced. It may be repeated that the series deserves every encouragement, and it is to be hoped that it will be carried to completion in the same good style as marks Mr. Dutt's works on the two eastern shires, Mr. Lydekker's on Hertfordshire, and Mr. Bradley's on Wiltshire. The volumes are really remarkable value for their price.

(4) A school-book with the title "By Road and River," suggests something of a novelty. And Mr. Wilmot-Buxton's treatment of geography as a school subject is a decided departure from the ordinary lines. For the most part, we like it very well, and so should the children who learn from it. Premising that most children have no great opportunity for learning geography by the very best method—travelling—the author invites them to "*pretend* to go on journeys from place to place" by rail, road, or river. The result is instructive and entertaining, even if the author occasionally goes rather far in colloquialism in order to keep his style attractive. Moreover, the sketch-maps and illustrations are quite above the average in such books—the illustrations are particularly well chosen. A few questions for exercise accompany each chapter.

(5) Mr. Webb's "Systematic Geography of the British Isles" forms a complete contrast to Mr. Wilmot-Buxton's book just noticed. The two might advantageously be used together, Mr. Wilmot-Buxton providing lighter reading to alleviate the hard facts which Mr. Webb makes little attempt to soften by picturesque writing. The study of geography in the skeletonic form in which Mr. Webb presents it is no doubt a necessity, and his book is a model of careful arrangement. He lays a greater stress than usual on geological formation, tabulating and explaining the different rocks found in these islands as simply as possible. A point open to criticism is found in the historical notes sometimes attached to the names of chief towns. Some of these remarks, in order to be understood, would either presuppose detailed historical knowledge, or necessitate so long an explanation that they had better have been omitted.

(6) The volume on Middlesex in that favourite series, "Highways and Byways," takes a high place among its companions. Mr. Hugh Thomson's illustrations are charming; we could almost blame them because they even beautify some of their subjects, when the artist shows us picturesque fragments divorced from the unlovely surroundings characteristic of suburban villages. The author admirably practises the style best suited to these volumes, a blend of pleasant description and historical gossip. It is well that such history should be preserved in accessible shape, when so much of the external evidence for it has been effaced.

(7) We cannot pretend to find much value in "Growls from Uganda." It is true that the author gives us some impressions, conveyed by a very ready pen, of his life in Uganda and his travels in British Columbia, and in these two countries he presents us with a perfect contrast, if nothing else. But the essays in which he offers views on various features of social life in England, even though they touch upon genuine abuses, seem generally to show little more than a mastery of the obvious, or to provide (as in the case of the tirade against motor cars) little else than a protest against the inevitable. Frankly, we should not have supposed these parts of the book worth printing, from whatever quarter of the globe they had been addressed.

O. J. R. H.

OUR BOOK SHELF.

Weather Indicator. Compiled and designed by Wm. Ballance. (London: G. Philip and Son, Ltd., n.d.) Price, in sheet form, 2*s.* 6*d.*; mounted, &c., 3*s.* 6*d.*

THIS is an issue in map form of what the publishers term a "weather indicator," to be obtained either in a sheet or mounted on rollers. The notes, tables, &c., have been compiled by Mr. W. Ballance, and the publishers suggest that the "weather indicator" will be found useful for schools, clubs, public libraries, hotels, boys' brigades, and boy scouts. The information given seems too elaborate, and might easily have been rendered more simple; it is not very scientific, but it probably aims to be chiefly of a popular character. Many of the so-called weather signs which are collated, especially those relating to the movements of animals, birds, and insects, have been handed down to us from the ancients, and are somewhat amusing. For country life, some quoted should undoubtedly receive attention, but the general belief in all would tend to much confusion. For town life many are altogether inapplicable. Such statements as "A white frost never lasts more than three days," "Quick thaw foretells long frost," "Hoar frost predicts rain," are bold, but probably incorrect. The wind scale given is not in accordance with recent knowledge; the equivalent velocity in miles per hour, and equivalent wind pressure in pounds per square foot for the several units of the wind scale, are very different from those now generally accepted. To be told as a sign for fair weather the barometer should be steady, or rising about 0·004 inch per hour; for rain falling slowly about 0·004 inch per hour; for wind falling gradually about 0·011 inch per hour; for wind and rain falling moderately about 0·015 inch per hour; and for stormy weather falling or rising rapidly about 0·021 inch per hour is precision which meteorologists have no knowledge of, especially when most of our barometers only read to hundredths of an inch.

Science and Singing. A Consideration of the Capabilities of the Vocal Cords and their Work in the Art of Tone Production. By Ernest G. White. Pp. 72. (London: The Vincent Music Co., Ltd., n.d.; Boston, Mass.: Thomas J. Donlan, 1909.) Price 4*s.* 6*d.* net.

THE writer of this book endeavours to show that the tones of the human voice are not produced by the vibrations of the vocal cords, but by means of movements or pressures of the air in the sinuses found in the frontal, supermaxillary, sphenoid and ethmoid bones, and which all communicate with the cavities of the nose; in short, his theory may be called sinus tone production. In our opinion the author has not succeeded in establishing his position. The facts of anatomy and physiology, and the data of experiment, are entirely against him. Nothing is more certain than that the vocal cords vibrate, and, on the other hand, one cannot conceive how vocal tones could possibly be produced by the cavities we term sinuses. These, no doubt, have their effect in modifying the qualities of vocal tones by resonance, and the quality of a so-called head voice may be so explained. The merit of the little book is that it is written in an interesting, breezy style by one who is obsessed by an idea, and that it is illustrated by a number of beautiful diagrams, evidently from actual photographs, showing the anatomical position of the various sinuses. The various pictures are admirable.

J. G. M.

Butterflies and Moths of the United Kingdom. By Dr. W. Egmont Kirby. Pp. lii+468. (London: Geo. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 7*s.* 6*d.* net.

THIS is a book comprising descriptions of the larger British lepidoptera (macro-lepidoptera), with coloured figures of them all in their perfect state, and many in the larval stage. There are also a few pages given to the micro-lepidoptera, with coloured illustrations of their characteristic species. It is a book of the popular rather than the scientific order, one for information and reference useful to collectors who wish to know where and when to find the objects of their pursuit. The coloured plates, of which there are no fewer than seventy, each comprising usually some twenty or thirty figures, are, as might be expected from the price of the work, not of a high order, but are often good, and probably always sufficient for the purpose of recognition, which is the main value of a work of this kind.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A New Oceanographical Expedition.

IN NATURE of November 18 (p. 71) there is a notice of a new oceanographical expedition, to be undertaken by the Norwegians in their surveying vessel *Michael Sars*, on the suggestion of Sir John Murray, and mainly at his expense. It is very gratifying to meet with cooperation of this kind in the prosecution of deep-sea research, and the investigation of the portion of the North Atlantic contemplated in the programme cannot fail to furnish interesting and useful results.

In the account of the expedition I note the following passage:—"The application of methods of high precision to the determination of the temperature and salinity of sea-water has yielded results which have raised considerable doubt in the minds of some investigators as to the validity of the earlier observations made by the *Challenger* and other expeditions, and the cruise of the *Michael Sars* should not only afford much entirely new information, but provide a means of valuing the earlier work."

As chemist and physicist of the *Challenger* expedition, I feel that this is a reflection, not only on the name of Challenger, but also on myself. I was a professional chemist of recognised standing at the date when the expedition was planned, and it was to this fact that I owed my selection for the post nearly a year before the ship sailed. During the whole of this time I was occupied with the study of the work to be done and of the methods to be employed in doing it. Some of these were devised by myself, and none were approved before they had been thoroughly tested on land; nor were they finally accepted until they had passed the probation of the first three months at sea. The regular work of the expedition began with the sailing of the ship from Teneriffe on February 15, 1873. By this time the scheme of the routine work of my department had taken definite shape, and it suffered but little alteration during the cruise. All the actual work was done by myself, and no method was employed which I had not myself tested and found to give, in my hands, thoroughly trustworthy results.

I think it is due to me and to the readers of NATURE that the investigators, in whose minds doubts have been raised as to the validity of the *Challenger* observations, should state them, with the grounds on which they rest, and also indicate how they expect the cruise of the *Michael Sars* to provide a means of valuing the earlier work.

November 27. J. Y. BUCHANAN.

Gametogenesis of the Sawfly *Nematus ribesii*. A Correction.

IN the *Quarterly Journal of Microscopical Science*, vol. li., 1907, p. 101, I described observations on the gametogenesis of *Nematus ribesii*, some of which subsequent work has shown to be erroneous. Since my statements have been quoted in several recent papers, I think it necessary to correct the mistakes as far as possible, although I have not yet reached a satisfactory solution of the phenomena. The errors arose partly through misinterpretation of the phenomena observed and partly through imperfect fixation, for I find that, unless the material is very accurately fixed, the chromosomes tend to adhere together and give the appearance of a smaller number than the true one. The same cause has led other observers to make similar mistakes.

Re-investigation of Nematus shows, in the first place, that there is only one division of the spermatocytes; the first division described in my paper is not a true mitosis, but is probably comparable with the abortive division observed in the spermatogenesis of the bee. I have not yet been able to determine the chromosome number with certainty. In the spermatogonia the number appears to be about sixteen, and that in spermatocyte mitoses about eight, but if eight is the true reduced number, the occurrence of sixteen in the spermatogonial mitoses of larvæ derived from parthenogenetic eggs is unexplained. In the bee, and as I find also in a Cynipid (to be published shortly), the spermatogonial number is the same as that of the spermatocytes.

I have not yet obtained fresh material for re-investigation of the maturation of the egg, but the results of my recent work on the spermatogenesis make it clear that my observations on the chromosomes in the polar divisions also require revision.

But the behaviour of the chromosomes in *Nematus ribesii* is so difficult to follow that it is possible that the true interpretation will be obtained only by the discovery of some nearly related species in which they are more clearly distinguishable. LEONARD DONCASTER.

University of Birmingham, November 27.

Are the Senses ever Vicarious?

[PROF. MCKENDRICK has sent us the subjoined letter received by him, and his comments upon it.—ED. NATURE.]

MY attention has just been directed to a letter which appeared in NATURE of March 11 (vol. lxxx., p. 38). It was signed by Prof. McKendrick, and dealt with the vexed question of the blind and their faculties.

I am a blind man, and have mixed with blind people of all ages for the past thirty years. You will grant that I ought to know something about the question you discuss in your letter.

Permit me to thank you for what you say about the popular notion that when a person loses his sight he is compensated by a gift of ability in one, if not all, his other faculties. The intelligent blind know how foolish this idea is, and constantly protest against it. The public, however, insist upon its accuracy, and calmly assume that the blind do not grasp the point at issue, or affirm that those who protest are unbelievers in the goodness of God. This assertion of compensation leads to all sorts of ridiculous notions, and has a very pernicious practical effect. The very people who assert the theory of compensation are among the number who shrink from providing facilities for the proper training and employment of the very gifted people they profess to look upon as the possessors of special talents. They impute to us the possession of all kinds of striking abilities, yet they decline to allow the specially talented to do what would earn or help to earn a livelihood. We are credited with mavellous powers in music, basket-making, &c., and yet when we assert our claim to live the ordinary life of the citizen these people are shocked at our audacity.

Now, the overthrow of the theory that we are specially compensated for the loss of sight will destroy the false impressions regarding our wonderful memories and all the other fantastic notions, and the way will be opened for common-sense treatment of the training and employment of the blind. It is notorious among the blind themselves that numbers of them are not at all musical, and that mechanical ability is not a conspicuous feature. Many blind are very deficient in hearing, in smell, and in the sense of touch itself. My own experience has compelled me to take heed of the varying degrees of what I shall call, for want of a better name, ear-power. The same variety exists in touch-power and memory-power. I should like to refer to these as well as many other interesting phenomena, but I fear I must content myself with asking your kindly attention to a problem which has baffled me for more than twenty years. Why does the voice call up before me the upper part of the speaker's face, and enable me to form a picture of the expression of the speaker? The expression of the eyes is frequently as vividly before me as when I could see. When people are speaking to me, they are never on guard to control their countenance as they would be if conversing with a sighted person. I am thus enabled to get a picture of the play of their emotions which helps me to come to conclusions as to character, &c. The lower part of the face was only once made visible to me, so that I could feel sure about it. I know when a person smiles, frowns, when the face lights up with an intelligence or when apathy and want of perception cloud the countenance. Sometimes I can follow the line of the glance and can point out where it would strike. When listening to public speakers I like to sit at an angle to them, and not in front. Can you point to anything that will aid me to come to a sensible conclusion on this matter of the voice conveying the picture of the upper part of the face, and thus help me to fathom a question which I am persuaded contains the key to many other problems as to the constitution of sound and the organ of sound?

George Irons Walker.

Westbury Street, Sunderland, October 28.

With reference to Mr. Walker's interesting letter, which bears out the opinion of Prof. Kunz and others that there is no special development of the other senses in those who have lost the sense of sight, I feel at a loss to give an adequate explanation of the curious experiences described by Mr. Walker. The only suggestion I would venture to make is that Mr. Walker may, by long and almost unconscious practice, have learned to associate certain tones of the voice, as regards quality of tone, with certain movements of the head that he supposes are made by the speaker at the time he utters the words. Tones of inquiry, surprise, reproach, affection, interest, have each a certain quality indicative of states of feeling (unless they are produced by mimicry), and the blind man may draw conclusions as to movement and state of feeling on the part of the speakers. He has then what Mr. Walker calls "a picture of the play of their emotions." I cannot explain why Mr. Walker has almost invariably a picture of the upper part of the face, nor why he prefers to sit at an angle to a public speaker instead of in front. His experience supports the view that the blind have not more acute sensory perceptions than those who see, but that they have cultivated the habit of close attention. This, in turn, stimulates their imagination, and gives them mental pictures of external things that are of no special importance to those who see.

John G. McKendrick.

Movements of the Red Spot Hollow on Jupiter.

Transit estimates of the Red Spot Hollow on Jupiter, obtained between 1908 December 20 and 1909 June 12 inclusive, show that that object exhibited an average monthly increase in longitude of 1·03°. Its motion, however, was not constant, inasmuch as it remained practically stationary in longitude during the last three months (April to June) of the apparition. The rotation periods of the three selected points of the Hollow, namely, the two shoulders and the middle, work out as under:—

Date	Long.	No. of transits	Elapsed rotations	Mean daily drift	Rotation period
			p. Shoulder.		
	°			°	h. m. s.
1908, Dec. 20 ... 1909, June 7 ...	358·5 4·8	16	408	−0·0376	9 55 42·2
			Middle.		
1908, Dec. 20 ... 1909, June 12 ...	13·6 18·4	15	420	−0·0274	9 55 41·8
			f. Shoulder.		
1908, Dec. 20 ... 1909, June 12 ...	31·1 37·1	20	420	−0·0344	9 55 42·1

The mean rotation period of the Hollow, therefore, appears to have been, as nearly as possible, 9h. 55m. 42·0s., a period which is 1·4 seconds longer than that of the adopted value of System II.

At the commencement of the observations, in December, the middle of the Hollow crossed the central meridian about twenty-three minutes subsequent to the passage of the zero meridian, and half an hour at the close of the apparition in June. This lagging behind may be regarded as a distinctly normal movement on the part of the Red Spot.

When the planet was observed last month as it emerged from the sun's rays, the Hollow was found to have moved at an accelerated rate of velocity during the unobserved interval since June. From transits obtained on October 15, 25, and 30, the deduced mean longitude of the middle of the Hollow was then 16·4°. This shows a decrease of 2° when compared with the longitude for June. It is evident, therefore, that the motion of the object had latterly become quickened. Had the Hollow continued to drift at the same rate as was exhibited from December to June, it would have crossed the central meridian ten minutes later than was actually the case last month. Owing to this slight displacement in longitude, the rotation period from June to October was shorter than that for the previous six months, and works out at 9h. 55m. 40·0s.

Leeds, November 21. Scriven Bolton.

Secondary Kathode Rays.

In a letter to Nature of April 2, 1908 (vol. lxxvii., p. 509), I described some experiments of mine which showed that for the corpuscular rays produced in metals by Röntgen rays there was a lack of symmetry between those coming from the side of the metals on which the primary rays were incident and those coming from the side from which the primary rays emerged. The ionisation produced by the emergence secondary corpuscles was, in general, greater than that produced by the incidence corpuscles. This was in accordance with Prof. Bragg's results for the corpuscular rays produced by γ rays (Nature, January 23, 1908, p. 270).

Since writing the above I have endeavoured to see if this lack of symmetry was dependent on the penetrating power of the primary Röntgen rays. Experiments were carried on only with gold and silver, and gave the following results. The average of four determinations with soft primary rays on silver showed the ionisation produced by the emergence to be 1·11 times as great as that produced by the incidence corpuscular secondary rays; eight determinations with hard primary rays gave an average ratio of 1·21. Five determinations with soft primary rays on gold gave the ratio of emergence to incidence ionisation as 1·03; nine determinations with hard primary rays gave a ratio of 1·09. The probable error of the mean in each case was ±0·01. It would seem, therefore, that there is a slight variation of the asymmetry with the hardness of the Röntgen rays, certainly in the case of silver, and very probably in the case of gold, the harder primary rays causing the ratio of the emergence to the incidence corpuscular rays to increase.

Though the hardness of the Röntgen rays could be varied, they were probably always very heterogeneous. I hope soon to repeat my experiments, using more homogeneous Röntgen rays, which have been recently made possible by the experiments of Prof. Barkla.

Charlton D. Cooksey.

Sheffield Scientific School, Yale University, New
Haven, Conn., November 17.

AN INTERNATIONAL MAP OF THE WORLD.

An International Committee assembled in London on November 15 to consider the form in which it is desirable to prepare a uniform map of the world on the scale of 1/1,000,000, or about sixteen miles to the inch.

The proceedings of this committee have aroused keen interest among geographers, and the results of its labours will be anxiously awaited. The meeting of this committee marks an epoch in map-making, and if its proposals are generally adopted, as no doubt they will be, there will be prepared a map of the whole world, uniform in design and execution, on a reasonably large scale.

Hitherto each country has, in the preparation of its maps, had in view solely its own requirements, and has made no effort to assimilate its maps to those of other countries, either in regard to scale, projection, method of representing hills, or in other points. Maps have been issued differing widely in these respects from those even of the adjoining countries.

The difficulty caused by this diversity of map design has long been felt, not only by those little versed in map reading, but by those who have constant occasion to work with maps.

It was not until 1891 that the first important step was taken towards obtaining a more uniform map of the world. In that year the International Geographical Congress at Bern raised the question, and the London Congress of 1895 passed a resolution recommending the scale of 1/1,000,000, or about sixteen miles to the inch, as suitable for a map of the world. This resolution was communicated to the various Governments in the hope that this scale might be generally adopted.

It was some time before this resolution produced much effect, but eventually Great Britain published a map of the United Kingdom on this scale, and commenced the publication of maps of Africa and Asia, while France and Germany commenced the issue and the United States the preparation of maps on this scale. Meanwhile the opinion of experts was coming round to the view that for the map of the world uniformity in many points other than scale is desirable.

At the meeting of the International Geographical Congress at Geneva in 1908 the subject was again considered, and it was decided to recommend for the 1/1,000,000 scale map the adoption of a uniform design, *i.e.* that the projection, methods of representing hills and other details, the conventional signs, amount of detail to be shown, and other points should be similar throughout. The various Governments were asked to prepare specimens on the 1/1,000,000 scale to illustrate their views as to style, &c.

Great Britain then invited the different Governments to appoint delegates to meet in London in order to consider draft proposals, which had meantime been elaborated, for the preparation of this map, and it was the delegates appointed in response to this invitation who recently met in London. The principal Powers of Europe, the United States of America, Canada, and Australia sent delegates, and the *personnel* of the committee was so strong that its recommendations must carry great weight.

Its report has not yet been published, but it may probably be assumed that the recommendations are substantially as given in the *Times* of November 22. These may be briefly stated as follows:—

(1) The adoption of the modified polyconic projection, and the division of the map of the world into sheets, each distinguished by a letter of the alphabet and by a name.

(2) A scale of kilometres, and, if desired, also of feet, to be printed on each sheet.

(3) Altitudes to be given in metres, and, if desired, also in feet.

(4) Ground forms to be shown by contours in brown and by coloured layers, as used in Bartholomew's maps and in some of the more recent maps of the Ordnance Survey. The contours to be at 100-metre intervals in the lower ground, and at greater intervals in the higher ground; ground forms not to be shown at altitudes above 7000 metres.

(5) Water to be shown in blue, perennial being distinguished from non-perennial water, also navigable from unnavigable rivers. Obstructions such as dams, locks, &c., to be shown, also fresh and salt marshes. Depths below the sea to be indicated by blue contours.

(6) Main roads to be distinguished from secondary roads, railways in running order from those under construction or projected; lines of telegraph, post offices, boundaries, towns and villages, &c., to be shown. A table of conventional signs was drawn up.

(7) Names to be in Latin character in the form adopted by the country in which the object is situated. Special rules were drawn up for translating names from other languages into the Latin character.

I think that all geographers will agree that these proposals, taken as a whole, are thoroughly sound and worthy of the distinguished geographical experts who form the committee; but there are some details of importance as to which assent to the proposals of the committee is likely to be less general, although probably the views of the committee will be widely accepted.

The scale of the map, about 1/16 inch to a mile, is sufficiently small to make it difficult to show a great deal of detail without overcrowding, and thereby detracting from the clearness of the map. In many countries it will be advantageous and also easy to show without overcrowding, all the detail contemplated by the committee, but in closely populated country such as parts of France, Germany, Great Britain, and the United States, it will, at any rate, be very difficult. If one studies the existing 1/1,000,000 scale map of England, which has perhaps rather less detail than the scale will admit of, it will be seen that the addition of much detail might overcrowd the map. It is not suggested that the committee proposes to show too much detail, but there seems to be a danger, unless great judgment is used, of overcrowding the map in close country, and it is to be hoped that in the preparation of the map of such districts this danger will be recognised and care taken to avoid it.

Another point on which opinions will differ is the recommendation that ground forms be shown by the layer system. This system is better suited for country with moderate altitudes, such as England, where it answers well, than for a map of the world, in parts of which the altitudes are great, and many would prefer ground forms to be shown by contours and shading. There is much to be said on both sides of the question, but there are undoubtedly some advantages in the method proposed by the committee, and no doubt in the end its judgment will prevail.

I will only refer to one other point, the only one on which I feel a difficulty in agreeing with the view of the committee. It is proposed to give all altitudes in metres. Now the area of the countries using the foot as a unit is very large, and the population is large in proportion to the area. To this large population the rendering of all heights in metres would be a great inconvenience. I do not think that on this scale it would answer to show, as has been suggested, both feet and metres. The question arises whether on this point absolute uniformity is essential. It appears to me that it is not, and that an endeavour might be made to give the heights in metres in countries in which the metre is the unit, and in feet where the foot is the unit. Of course, some give and take would be necessary in parts like the centre of Africa, so as to avoid numerous changes of unit, and hence some countries would have their heights given in the unit they are not accustomed to; but this would be a smaller matter than giving altitudes in a unit unfamiliar to all countries using the foot. The loss of uniformity which this would entail would, in my opinion, be a less evil than that of giving all altitudes over a considerable part of the world, including some of the busiest countries, in terms of a unit not ordinarily used in the business of the country.

I have called attention to a few points in which the proposals of the committee may be questioned, as it seems advantageous that such points should be discussed, but these points sink into insignificance compared with the solid and undisputed value of the work done by the committee. The convenience of being able to get a map of any part of the world, on a reasonably large scale, uniform in style and execution with any other part, will be great to statesmen, business men, travellers, and to all who use maps. To statesmen they should be of special value. International disputes and many mistakes have been caused by working on defective maps of varying scales; when this new map is issued, as no doubt it soon will be, one source of such errors will disappear. It may be wondered now that a uniform map of the world has not been sooner projected. None the less credit is due to those who originated the idea, who persevered in advocating it in spite of some discouragement, and have elaborated the details with such thoroughness as to make the success of the map practically sure.

DUNCAN A. JOHNSTON.

TUBERCULOSIS AMONG THE INDIANS OF NORTH AMERICA.[1]

THE increasing prevalence of tuberculosis among the North American Indians has for some time attracted attention, and the results of a detailed investigation of hygiene in the Indian reservations form the subject of a report by Dr. Aleš Hrdlička, published in the 42nd Bulletin of the Bureau of American Ethnology.

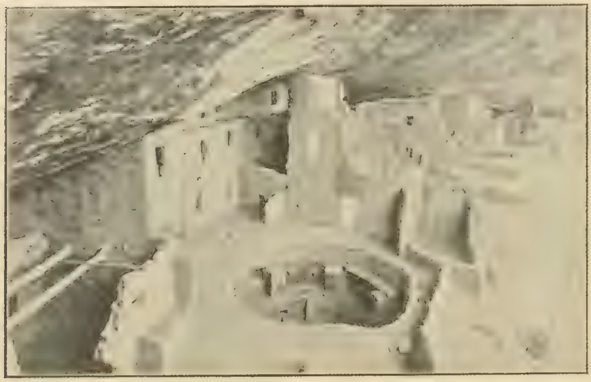

Fig. 1.—A Kiva of Spruce-Tree House—a large ruin in Mesa Verde Park, Colorado.

The facts disclosed in the course of this inquiry are striking and alarming. This disease, which threatens to exterminate the Indian population, seems not to have existed among the natives of the continent prior to the arrival of the whites. While the country was still largely unsettled they were accustomed to a natural and active life, were inured to hardship, and were, as a rule, provided with more suitable food. These conditions have changed with the advance of civilisation. At present the Indian is more susceptible to the disease than the white man; in other words, his system is less immune owing to the more recent introduction of infection among the race.

These inquiries sufficiently explain the etiology of tuberculosis among the inhabitants of the reservations. Infection is facilitated, particularly in the cold and rainy seasons, by the neglect of hygienic precautions, especially from overcrowding and lack of ventilation. No care is taken to destroy the infective sputum, the tubercle bacillus being dispersed by the common use of vessels, clothing, and musical instruments, while "pipe passing," the usual mark of hospitality, is common. In addition to these contributory causes, there seems to be now a well-established hereditary tendency, which is developed by exposure, dissipation, indolence, and other causes contributing to bodily weakness. There seems also to be little doubt that the disease is spread by milch cattle infected with tuberculosis. Lastly, the patient, with the well-known stolidity and resignation of his race, is unable to resist the progress of the disease as soon as he understands that he is infected.

The remedies suggested to improve this condition of things are increased attention to hygiene, disinfection of the sputum, and isolation of the sick. It is clear that there will be considerable difficulty in enforcing precautions of this kind among such a people. Dr. Hrdlička gives a significant warning that curators of museums should be on their guard against the danger of carelessly handling, without previous disinfection, articles, particularly fabrics, received from Indian homes.

The conditions of earlier Indian life are illustrated in an interesting way by the report published in the 41st Bulletin of the Bureau, by Dr. J. W. Fewkes, on the cliff-dwellings known as the Spruce-Tree ruins in the Mesa Verde National Park, Colorado. Here we find Kivas, or circular pit-dwellings, in connection with the series of caves once inhabited by a now forgotten race. With a view to mutual protection, a population of some four hundred souls was crowded within this narrow area. Dr. Fewkes believes that he can explain the reason why the Kivas are built underground and are circular in form, on the theory that both conditions are survivals from the ancient pit-houses or subterranean dwellings of a still earlier race. From this point of view the Kivas form the most ancient part of the existing ruins. These people lived in the age of stone, no metal implements, even those of copper, having been discovered. They had some belief in a world beyond the grave, because they laid mortuary offerings with the dead. Their conditions of life resembled those of the Pueblo population, and as these survived until comparatively modern times it is very difficult to assign a date to

Fig. 2.—Oglala Dwellings. Triple log-house under construction and temporary tent-house.

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[1] Smithsonian Institution. Bureau of American Ethnology.

Bulletin 41: Antiquities of the Mesa Verde National Park, Spruce-Tree House. By Jesse Walter Fewkes. Pp. viii+57; 21 plates. (1909.)

Bulletin 42: Tuberculosis among certain Indian Tribes of the United States. By Aleš Hrdlička. Pp. vii+48; 22 plates. (1909)

the present ruins. They lived by a rude kind of farming, growing maize, beans, and melons; their women had some skill in pottery. They seem to have used their underground Kivas as places where they carried on a constant round of tribal ceremonial. They lived a retired life, and were little influenced by foreign culture. The ruins have now been carefully restored under the supervision of Dr. Fewkes, whose report, fully illustrated, gives an excellent account of a strange forgotten race.

LOW-TEMPERATURE RESEARCH AT THE ROYAL INSTITUTION.[1]

A SUMMARY of the work carried on with the aid of the Hodgkins Trust is, by the authority of the managers, incorporated in the Proceedings of the Royal Institution every seven years. Like the preceding report, which chronicled the solidification of oxygen, the liquefaction of fluorine, and the liquefaction and solidification of hydrogen, the essay in which the achievements of the years 1900 to 1907 are described by Prof. Armstrong is again concerned mainly with low-temperature investigations.

No fewer than thirty-five original publications are referred to, the main feature running through them being the discovery and use of the charcoal vacuum, a practical advance only less important than the introduction of vacuum vessels in the manipulation of liquefied gases. At the temperature of liquid air the absorption is from six to thirty-four times as great as at 0°, and depends but little on the pressure, so that very high vacua can be produced. The density of the occluded gas is substantially that of the liquid, 0·06 against 0·07 for hydrogen, and 0·17 against 0·15 for helium. Owing to their slight absorption by charcoal at −185°, the presence of hydrogen and neon in air can be detected readily by connecting a vacuum tube with a vessel containing charcoal cooled in liquid air; if the gas be enriched by starting with a larger quantity and submitting it twice to condensation by cold charcoal, the spectrum of helium can also be detected.

The fact that helium is not condensed by charcoal at −185° was made use of by Prof. Onnes in the experiments which culminated in the liquefaction of helium, the one gas which had resisted all attempts to liquefy it at the commencement of the period under review; only by this means was it possible to maintain the purity of the helium and to ensure that the circulation of the gas could be maintained undisturbed by condensation of solid hydrogen and solid air. The indebtedness which he owed to Sir J. Dewar's discoveries was fully and generously acknowledged by Prof. Onnes in recording this great achievement.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held as usual on St. Andrew's Day, Tuesday, November 30, when the report of the council was presented, and an address was given by the president, Sir Archibald Geikie, K.C.B. An account of the main subjects that occupied the attention of the council during the past year is given in the report, from which extracts are here subjoined. Other matters mentioned in the report have been referred to already in these columns.

REPORT OF THE COUNCIL.

Results of the National Antarctic Expedition.

The only part of the physical observations of the National Antarctic Expedition, of which the Royal Society undertook the preparation and publication, that remains to be completed is the second volume on meteorology, which is now in progress. It will consist chiefly of synchronous charts of sea-level pressure, with winds and temperatures, over the greater part of the southern hemisphere. It will thus embody, not only the results of the observations made by the *Discovery*, but information derived from many other sources. The preparation of these charts is in the hands of the Meteorological Office under Dr. Shaw. It is anticipated that this laborious task will be completed in time to allow the volume to be published next year.

Glass-workers' Cataract.

The inquiry into the disease known as glass-workers' cataract, instituted at the request of H.M. Government, and referred to in the last report, has been pursued during the year by the committee appointed by the council. The scheme of operations drawn up by the committee includes experimental research in the laboratory, and also investigations at some of the principal glass manufactories, with the view of obtaining data of the processes of glass-manufacture and of the incidence of the disease among operatives. Some progress has been made in this latter branch of the inquiry, but the work of the committee has been hindered by the refusal of certain glass manufacturers to allow the committee to visit their works. The experimental researches in the laboratory are proceeding.

The National Physical Laboratory.

The need for increasing accommodation is greatly felt in several departments. This is specially the case in the department of metallurgy, referred to by Lord Rayleigh in his address last year. With regard to this the executive committee of the laboratory report:—

"Investigations of very real importance have to be declined, because of the need of appliances, and the general scale of the arrangements is much too small. A site is available for a new metallurgical laboratory adjoining the chemical laboratory, and it is highly desirable that during the coming year active steps should be taken to secure the necessary funds. The committee commend this need to metallurgists interested in furthering investigations into the application of science to the practical treatment of metals and to other problems of importance."

The executive committee have nominated a special committee to raise the necessary funds for extension in this and other directions.

The most important event of the year, however, has been the work of construction of the national experimental tank, given to the laboratory with great generosity by Mr. A. F. Yarrow; this work is now well advanced. In April last Mr. Yarrow wrote to the secretary of the Institution of Naval Architects directing attention to the importance of such a tank, and offering to present a sum of 20,000*l.* on the understanding—

(1) That a tank of the most modern character can be established for a sum not exceeding 20,000*l.*, and that it be established at the National Physical Laboratory.

(2) That suitable provision be made, both as regards staff and means, for conducting research work, as well as for experimental investigations of a confidential character which private firms may desire, and for which they would pay suitable fees.

(3) That a sufficient sum be provided to ensure that the tank be efficiently carried on for a period of not less than ten years. This provision might take the form either of an endowment or of guaranteed subscriptions from shipbuilders and ship-owners.

Mr. Yarrow's letter continues:—"I believe that an adequate provision for maintenance would involve not less than 2000*l.* a year; that is to say, a total guarantee fund of 20,000*l.* would be required to maintain the efficient working of the tank for the above period."

In accordance with Mr. Yarrow's suggestions, a committee was formed by the Institution of Naval Architects to study the practicability of the scheme and the raising of the maintenance fund. Towards the end of the year this committee informed the executive committee of the laboratory that about half the funds required had been promised, and that it was anticipated that the remainder would be forthcoming in due course; they also asked for an expression of the views of the executive committee and a statement of the conditions under which the tank could be worked as a department of the laboratory. The executive committee replied that if the guarantee fund were now raised to at least 1200*l.* a year, and if the experimental tank committee would undertake to continue their endeavours to increase it further with the view of research, the executive committee would be willing to take the responsibility for the expenses of working the tank in accordance with Mr. Yarrow's proposal. The governing body of the laboratory have thus made themselves responsible for an expenditure which may amount to 800*l.* per annum for ten years, and will receive in return the fees which are expected to come from tests carried out for ship-builders. On his part, Mr. Yarrow has paid over cash and securities to the value of at least 20,000*l.* to the treasurer of the Royal Society, and the president and council have conveyed to him the cordial thanks of the society for his most generous action.

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[1] Low-Temperature Research at the Royal Institution of Great Britain, London, 1900–7. Essay by Prof. H. E. Armstrong, F.R.S. II. The Charcoal Vacuum Septenate. Pp. 63. (Hodgkins Trust, 1909.)

During the year the executive committee have also, at the request of H.M. Government, undertaken important and onerous responsibilities on the scientific side of the experimental study and improvement of the conditions governing artificial flight.

International Catalogue of Scientific Literature.

The whole of the seventh annual issue of the catalogue has been published with the exception of D (chemistry), M (botany), O (anatomy), P (anthropology), and Q (physiology). These five volumes, as well as several volumes of the eighth issue, are in the press.

The International Council of the Catalogue, which had held meetings previously in 1900, 1904, and 1907, met again this year on June 3 and 4 in the rooms of the Royal Society.

The International Council made arrangements with the view of diminishing the cost of production of the catalogue, and also passed the following resolution:—

"That the regional bureaus be requested to confer, before April, 1910, with scientific workers in their several countries, so that any opinions and proposals of those to whom the catalogue is of consequence may be laid before the International Convention in 1910."

At the meeting of that convention important decisions must be made regarding the future of the catalogue; accordingly, the council of the Royal Society has appointed a committee to consider and report upon their relation to this undertaking.

Research on Tropical Diseases.

The investigations of the action of drugs upon trypanosomes, referred to in previous council reports, have been continued under the direction of a subcommittee, and accounts of the principal results of these investigations have been published from time to time. The latest progress report, by Mr. H. G. Plimmer and Captain Fry, "On the Experimental Treatment of Trypanosomiasis," appeared in Proceedings, B, No. 549, October 9.

During the present year the inquiry into sleeping sickness in Uganda has been actively pursued by the Royal Society's commission, which left England in October, 1908, under the direction of Colonel Sir David Bruce. Three papers on the work of the commission have been received from him during his stay in Uganda, and have been published in the Proceedings, viz.:—(1) "*Trypanosoma ingens*, n.sp."; (2) "The Development of *Trypanosoma gambiense* in *Glossina palpalis*"; (3) "A Note on the Occurrence of a Trypanosome in the African Elephant."

The second of these papers contains an account of an experiment carried out by the Commission, the results of which confirm the important conclusion arrived at by Dr. Kleine in German East Africa, that the tsetse-fly *Glossina palpalis* may be infective for a considerable period after the fly has fed on an infected animal. Previously it had been believed that the carrying of infection from a sleeping-sickness patient to a healthy person by the *Glossina palpalis* was a mechanical act, and that the power of transferring the disease was lost to the fly forty-eight hours after it had fed on an infected person. Dr. Kleine, however, has recorded observations of the fly remaining infective for much longer periods, extending up to sixty-six days, and now Sir David Bruce has reported further experiments, carrying the duration of infectivity as far as seventy-five days. This confirmation of Dr. Kleine's observations makes it necessary to revise previous conclusions on this point, the importance of which is obvious owing to its bearing on the nature of such preventive measures as have been hitherto attempted.

At the suggestion of Colonel Sir David Bruce, a conference, composed of medical (including veterinary) officers in British East Africa and Uganda, together with representatives of the administration of those protectorates, was held at Nairobi, in May, under the presidency of Sir David Bruce, to discuss and make recommendations as to preventive and remedial measures in regard to both human and animal trypanosomiasis.

Sir David Bruce is leaving Uganda this month, but arrangements have been made which will admit of the work of the commission being carried on after his departure.

Tyndall Donation.

During the current year Mrs. Tyndall, in pursuance of a wish expressed by her husband, the late Prof. Tyndall, has entrusted to the Royal Society the sum of 1000*l.*, to be administered at the discretion of the president and council for the purpose of encouraging and furthering research in all matters pertaining to mining, including such questions as ventilation, temperature, diseases incident to miners, and any other lines of scientific inquiry conducive to the improvement of mining and the lot of the miners.

PRESIDENTIAL ADDRESS.

In his presidential address, Sir Archibald Geikie referred first to the losses by death of distinguished fellows of the society since the last anniversary meeting. On the foreign list he had to record the decease of five men of wide reputation, namely, Albert Gaudry, Simon Newcomb, Anton Dohrn, Georg von Neumayer, and Julius Thomsen. The society also lost by death during the year the following fellows on the home list:—Daniel John Cunningham, David James Hamilton, Rev. W. H. Dallinger, Wilfrid Hudleston Hudleston, Harry Govier Seeley, Arthur Gamgee, Gerald Francis Yeo, Thomas William Bridge, Sir George King, Francis Elgar, Bindon Blood Stoney, George Gore, and William James Russell.

The special subject to which the president's address was devoted was the work in which the Royal Society is engaged. It is not commonly known that the weekly meetings and the publications to which they give rise, though they constitute the most important part of the labours of the society, so far as relates to the progress of discovery, form only a portion of a programme which is every year becoming fuller and demanding more time, thought, and funds for its accomplishment. Sir Archibald Geikie gave, therefore, a brief outline of the various directions in which the energies of the society are employed, in the hope that when some of the difficulties become more widely known, means may be found for adequately coping with them.

When the Royal Society was founded it was the only learned body in this country specially devoted to the prosecution of scientific inquiry, and such it continued to be for generations; but the rapid growth of science during the last century has shown that no single society can now serve to supply the needs of the whole vast field of investigation in every department of nature. Most of these departments, one after the other, have had special societies created for their exclusive cultivation, each of which records the progress of research in its own territory. At first the Royal Society, long accustomed to reign with undisputed sway over the whole realm of natural knowledge, was disposed to look with disfavour on this multiplication of separate and independent institutions; but that time has long since passed away. Subdivision is now admitted to be necessary, and, if properly directed, even desirable. Hence this society, like a proud parent, now rejoices in the growth and energy of the increasing family which has grown up around her, while she in turn is regarded with respect and esteem by the various members of that family, among whom there is a general desire to be enrolled in her ranks.

Nevertheless, it is impossible not to perceive that the rise of all these younger societies has materially affected the position of the Royal Society in regard to the general advance of modern science. This society is no longer the general depository of the records of that progress in all its branches. So completely, for instance, do the Geological and Chemical Societies provide for the requirements of their respective fields of investigation that communications from these fields come now comparatively seldom before us. If one desires to follow the modern growth of geology or chemistry, one must turn for its record to the publications, not of the Royal Society, but of the two learned bodies that are specially devoted to the cultivation of these sciences. Nor can we see any reason why this process of devolution should not continue in the future. Hence, if the system of reading and publishing papers which has been in use here for so many generations is to be perpetuated without modification, there may come a day when every great department of natural knowledge will be provided with its own special society, and then we may ask in anticipation, what will be left for the meetings of the Royal Society? For myself I do not believe that such a time of impoverishment ever will befall us. We cannot, and would not if we could, do anything to prevent the foundation of fresh societies for sciences that have not yet been provided with them; but we may so adjust our programme as to bring it into harmony with modern conditions, and thus to maintain and extend the prestige and usefulness of the Royal Society. The danger to which I have referred, however, is by no means imaginary, and it should be faced before it has time to become serious.

Some years ago the society departed from the time-honoured practice of dealing with natural knowledge as one great subject, and now groups its papers in two separate series, one devoted to physical (A) and the other to biological (B) questions. It is undoubtedly a considerable convenience to have the memoirs in each of those two great divisions gathered together into a separate series of volumes. More recently the practice has grown up of introducing a similar principle in the grouping of papers to be read at the weekly meetings of the society. It was hoped that by taking the physical papers on one day and the biological communications on another a better attendance could be secured, especially of the representatives of each division. I cannot say that this arrangement has been attended with the success which was anticipated.

That there are some practical advantages in this separation of subjects cannot be gainsaid, and I would not for a moment seek to undervalue them; but I confess I am often led to consider this subject with feelings of regret and misgiving, and to ask myself whether the conveniences afforded by the subdivision are not more than compensated by the disadvantages that accompany them. Undoubtedly, the constantly quickening pace of the march of science makes it every year increasingly difficult for those whose lives are devoted to the active and engrossing prosecution of research in one special department of inquiry to keep in touch even with the broader features of the advance that is being made in other departments. We cannot be surprised that a man whose whole energies are absorbed in one line of study should neither care to listen to, nor to burden his library shelves with, papers in other lines, full of technicalities which he has had no time to master, and written, therefore, in a language which to him is more or less unintelligible. In this way the workers in widely separated fields of inquiry tend to be more and more completely isolated from each other.

But surely such isolation is a defect in our organisation which deserves serious attention. It cannot be for the general good of scientific progress that the eyes of an investigator should seldom or never be lifted from his own field of work, nor his ears be open to the reports of the advances made in other fields that lie outside his immediate interests. The wider his outlook, the greater must obviously be his capacity for judging of the general bearings of discovery in his own domain on other departments of research, and the broader and more intelligent will be his sympathies with the whole range of activity on which the continued march of natural knowledge depends.

The Royal Society is still the one great institution in this country which draws its members from the cultivators of every branch of science, and freely opens its publications to receive their communications of observation and discovery. It should thus be specially fitted to bring the workers on the two sides of science, physical and biological, into touch with each other. It has recognised, and in various ways endeavoured to discharge, its duty in this respect. In its Croonian and Bakerian lectures it has given to the world many masterly expositions of the progress of research in different branches of inquiry. It has likewise provided, by one of its standing orders, for occasional meetings devoted to the discussion of papers of general interest specially prepared for the purpose. Nevertheless, it may be urged that some more frequent and effective procedure might still be devised to lessen the evils of isolation and to make the work that is in progress in one section of the scientific domain more comprehensible in the others. It is futile to find fault with the technicalities of a science. These are its symbols and language with which its students cannot dispense; but without trying to provide for all the needs of the "man in the street," it is often possible to give the gist of an observation or a discovery in simple words that will convey a definite conception of what has been observed or discovered; and thus a subject which, when expounded in brief technical phraseology, repels men of another science, may yet be made interesting and suggestive to these same men.

It may be worthy of consideration whether in those branches of science which, having special societies of their own, are seldom represented by papers at our meetings or in our publications, some of their cultivators might not be invited from time to time to bring before the society reports of recent advances in their different fields of research. Would it not be practicable, for example, to find among the many distinguished chemists in our ranks a few who would be willing to present occasionally at our meetings, in language intelligible to a general audience of scientific men, an outline of the latest progress, present condition, and future problems of some section of their great science?

But, above all, there is an aspect of scientific thought which, although fully recognised by the early fathers of the Royal Society, is too apt to be overlooked amidst the engrossing pressure of modern research. I allude to the philosophy of science. At intervals in the progress of scientific inquiry it is desirable to look at the subject from the philosophical side, and to seek for a correlation and synthesis of the various processes of nature which discovery has revealed. The mental vision required for this quest is not given to more than a few gifted minds; but we can count among the number of our fellows more than one admirably qualified by wide knowledge and rare powers of generalisation to present a connected view of the broader bearings of discovery in the scientific domain in which each is a master. Memoirs of this type will, I trust, continue to be laid before us, perhaps at more frequent intervals, thus upholding the renown of our Philosophical Transactions and sustaining the prestige of the society.

Had the Royal Society no other duties to discharge save those in connection with the preparation of its publications, it would, like other scientific societies, have work enough on hand fully to occupy its time and absorb its resources; but the performance of these duties fills up only part of its programme. In this respect the society differs from other learned bodies. It possesses a large and diversified field of activities about which most, even of our fellows, know little, and the world outside still less. Our Yearbook, indeed, presents a formidable list of the public functions which have devolved upon the Royal Society. That list, however, conveys no adequate idea of the varied and even exacting character of some of its items; but, over and above the functions therein enumerated, others of a less public kind make large demands upon the time and thought of many of our fellows.

For many years past the Royal Society has acted as a kind of board of advice to the Government of the country in matters wherein scientific knowledge is required. In this informal capacity the society has been requested to undertake the conduct of many inquiries in the public interest. It has been likewise entrusted with the administration of funds voted by Parliament for the promotion of investigation.

Requests are not infrequently made to the society by different Government departments for advice or cooperation in matters wherein expert scientific knowledge is required. For years past we have had a tropical diseases committee, which, in association with the Colonial Office, has been carrying on investigations into the nature and prophylaxis of some of the maladies incident to the human and animal populations of our colonies and protectorates in warm climates. A commission dispatched by this committee to Uganda has for some time been at work, under Sir David Bruce, studying the decimating scourge of sleeping sickness, while another commission, under the same committee, is busy in London searching experimentally for some drug that may be effective in the treatment of that terrible disease. A few years ago, at the joint instance of the War Office, Admiralty, and Colonial Office, we dispatched a commission to Malta to investigate the peculiar fever which had for so long a time reduced the effective strength of our garrisons and fleets in the Mediterranean. The observers were fortunate in soon discovering the source of the disease, and were able to point out the steps to be taken to cope with it. The result has been that this serious malady has now been almost entirely banished from the hospitals of Malta. At present another committee of the society is engaged, at the request of the Home Office, in studying the disease known as glass-workers' cataract. The India Office likewise applies to us for advice, and we have an "Indian Government Advisory Committee" and an "Observatories Committee," the duty of which is to consider the reports of various public departments in the great dependency, and to offer suggestions towards the improvement of their scientific operations.

Although the Royal Society administers annually a considerable sum of money, by far the largest part of the disbursements is ear-marked for various special applications, and cannot be employed for other objects. So far, indeed, as its general purposes are concerned, the society cannot be regarded as adequately provided. For nearly two hundred and fifty years it has continued to hold aloft the torch of science, but the constantly augmenting demands of modern progress make its task increasingly difficult of satisfactory performance. I have referred to the growing cost of our publications, and there are other parts of our organisation wherein the development of our work is hampered by the lack of funds. Men of science are seldom rich; it is therefore all the more gratifying to be able to record examples of the continuous generous liberality of our fellows; but it is hardly from our own ranks that we can look for any substantial addition to our resources. Perchance in the general community there may yet be found some men who may be led to see that, besides the various laudable objects that have hitherto claimed their care, the advancement of science is likewise an important public and educational interest, and that benefactions are not unworthily bestowed in enabling the Royal Society adequately to maintain the great work which it has inherited from the past.

MEDALLISTS, 1909.

Copley Medal.

The Copley medal is this year awarded to Dr. George William Hill, For.Mem.R.S. Now that Simon Newcomb is no longer with us, Dr. Hill occupies, beyond challenge, the first position in the great subject of dynamical astronomy.

His processes are not only marked by extraordinary originality, the result of high mathematical genius, but also in every case his methods and researches are directed towards practical astronomical ends. His supreme work is probably contained in his researches on the theory of the moon's motion, which has remained the great problem of gravitational astronomy ever since the time of Newton. Here his introduction and development of the principle of disturbed periodic orbits has given an entirely new direction to the science, culminating recently in the lunar tables of E. W. Brown, which mark an epoch in the practical side of the lunar theory.

This work of Hill has been fruitful in new advances in many directions. His ideas have given rise, as developed by Poincaré and other investigators, to new departments of abstract mathematical analysis, while in the hands of Lord Rayleigh they have shed light on important and difficult problems of general mathematical physics.

His collected works have recently been published by the Carnegie Institution of Washington in four quarto volumes; the importance of their contents can hardly be overestimated. M. Henri Poincaré, in his introduction to these volumes, described Hill as "une des physionomies les plus originales du monde scientifique américain."

Astronomy owes to him new theories of the motions of the systems of Jupiter and Saturn, to which the whole of vol. iii. of his works is consecrated.

His shorter papers deal with nearly every problem in the lunar and planetary theories, with mathematical geodesy, and other subjects. All his work is characterised by its original points of view combined with practical aims, by maturity of thought, and high suggestiveness. It forms an index of the simplicity and aloofness of its author, who has been one of the main ornaments of astronomical science for more than a generation.

Royal Medals.

One of the Royal medals has been awarded, with the approval of His Majesty the King, to Prof. Augustus Edward Hough Love, F.R.S., in recognition of his numerous and important contributions to mathematics, and especially to mathematical physics. He has written many valuable papers on various branches of hydrodynamics, in particular on the theories of jets, of vortex motion, and of revolving gravitating masses of liquid. He is the author of a work on "Elasticity," now in its second edition, which is highly appreciated at home and abroad, and ranks as the standard treatise on the subject. In this he has incorporated various valuable researches of his own, which have appeared in the Philosophical Transactions and elsewhere. He has further investigated closely the circumstances of wave-propagation in air, in elastic solids, and in the electromagnetic medium, and has examined in particular the phenomena which present themselves at wave-fronts when the motion is discontinuous. More recently he has published remarkable papers on terrestrial physics, including a speculation on the origin of the present distribution of land and water, and an investigation of the precise extent of the inferences which can be drawn as to the internal constitution of the earth from the observed *data* relating to the heights of ocean tides of long periods, the lunar disturbance of level, and the approximate period of the small movements of the Pole over the earth's surface.

His Majesty has likewise approved of the award of the other Royal medal to Major Ronald Ross, F.R.S.

The name of Major Ross has become widely known on account of the important investigations which he has carried out on the life-history of the malarial organism and the means of preventing malarial infection. Following up a clue indicated by Manson, he began, in 1895, at Secunderabad, in India, in circumstances which entailed much difficulty and many delays, an investigation as to whether the malaria parasite, discovered by Laveran, passes part of its life-history within the body of a biting insect. After more than two years of fruitless experiments Ross discovered a stage of the human malaria parasite in the tissues of a mosquito (Anopheles) which had been allowed to feed on the blood of a malarial patient. In 1898 he proceeded to work out in detail the life-history of a malarial parasite found in sparrows and larks in India. He traced the complicated stages in the development of this parasite from its inception into the stomach of a gnat (*Culex fatigans*) which feeds on the blood of these birds to its passage back into their blood through the secretion of the poison gland of the insect. At the same time he furnished conclusive experimental proof of the part played by the insect in propagating the infection. These fundamental observations have been confirmed and extended in various directions by other observers, both in the British Empire and elsewhere.

As a practical consequence of the discoveries of Ross and those who have followed in his footsteps, and of his own unceasing exertions and further investigations during the last few years, scientifically directed measures for the prevention of malaria have been initiated with striking success in many fever-stricken districts all over the world, and particularly within the British Empire. His investigations have also inspired similar work on the spread, by means of mosquitoes or other biting insects, of other formidable diseases, with the result that effective measures have been devised for preventing the spread of these diseases also.

Davy Medal.

The Davy medal has been awarded to Sir James Dewar, F.R.S.

Sir James Dewar has been a pioneer in the study of very low temperatures, their production, applications, and effects.

For many years he has worked continuously in this difficult domain, and his investigations have resulted from time to time in such achievements as the solidification of oxygen, the liquefaction of fluorine, and the liquefaction and solidification of hydrogen. His improvements in technique have been fundamental. By the construction of vessels in which thermal convection is avoided by the presence of a vacuous layer in their walls, he has enormously simplified the retention and manipulation of matter at very low temperatures. His application of the absorbent effect exerted on gaseous materials by charcoal at low temperatures has placed in the hands of chemists and physicists a most convenient and important method, not only for the production of high vacua, but also for the rapid separation of the constituents of gaseous mixtures. The modifications in the properties of matter at very low temperatures have been investigated, and remarkable results obtained, including the earliest exact investigations, jointly with Prof. Fleming, on the electric properties of insulators and of metals and alloys. The determination of the properties (critical points, boiling points, &c.) of refractory gases at very low temperatures has involved the practical downward extension of absolute thermometry, with the result that temperatures in the neighbourhood of the absolute zero can be determined correctly to within a degree. Lastly, recent measurements of the rate of formation of helium from radium salt, specially purified by Sir T. Edward Thorpe for his recent atomic weight determination, have provided exact molecular data, throwing light on the nature of the spontaneous disintegration of that very remarkable substance.

Hughes Medal.

The Hughes medal falls this year to Richard Tetley Glazebrook, F.R.S.

Dr. Glazebrook has for many years been closely identified with the construction, testing, and evaluation of electrical standards. Not only has he published important memoirs on these subjects, but, as secretary for a very long period of the Electrical Standards Committee of the British Association, and more recently as director of the National Physical Laboratory, he has taken a leading and responsible part in this type of scientific work and in conferences of international importance. It is thus specially fitting that he should be the recipient of the Hughes medal.

The anniversary dinner was held at the Hotel Metropole on Tuesday evening. Sir Archibald Geikie occupied the chair, and a large number of fellows and distinguished guests was present. In proposing the toast of "The Royal Society," Mr. Butcher, M.P., remarked that organised science presents the most signal example of cooperative enterprise in the things of the mind. Modern scientific research demands a host of humble labourers in every field. The hewers of wood and the drawers of water are as necessary as the men of genius. Like the builder of a mediæval cathedral, the obscure worker in the laboratory adds his stone to the fabric, and passes from sight; the individual is effaced, and the structure that slowly rises is the collective achievement of many forgotten workers and even of many generations, guided, however, by a few master minds. While art and literature bear the stamp of permanence, the movement of the sciences produces another kind of effect—that of progressiveness and limitless expansion. Yet, in spite of this irresistible forward movement, the man of science, like the artist, is aware that the ideal may still escape his grasp, and that the quest of truth still remains the search for something that must ever be pursued, that ever recedes, and never can be wholly attainable.

Replying to the toast, the president said that at its foundation every side of intellectual life seems to have been represented in the society. The non-scientific elements which so preponderated at the start were gradually reduced as years went on, but a wide and liberal view of the claims of admission continued to be taken, and the more distinguished in each generation in affairs, in literature, and in art were elected as fellows. This custom is still kept up, but with increasing stringency, until now the number of such persons is limited to two in every two years. There are some fellows who believe that the general interests of the society would be promoted by the introduction of a larger leaven of culture which is not scientific.

The Japanese Ambassador, responding to the toast of "The Guests," said it is barely forty years since Western science was transplanted into Japan on anything like an adequate scale. For the progress being made Japan owes an immense debt of gratitude to the scientific men of the West, and particularly to scientific men of Great Britain.

NOTES.

The meeting of the Royal Irish Academy on Tuesday, November 30, was occupied by a commemoration of Charles Darwin, the date nearly coinciding with that of the publication of "The Origin of Species" fifty years before. The president, Dr. F. Tarleton, opened the proceedings, and the following short addresses were given on the influence of Darwin's work:—geology, Prof. G. A. J. Cole; geographical distribution of animals and plants, Dr. R. F. Scharff; zoology, Prof. G. H. Carpenter; botany, Prof. T. Johnson; anthropology, Prof. A. F. Dixon.

The Washington correspondent of the *Times* announces that a recommendation is to be submitted to the Department of Commerce and Labour by the Bureau of Fisheries that the Government should bring about an international conference for the formulation of an international marine game law to protect from extinction seals, whales, walruses, and other sea mammals. The countries which would be invited by the United States to send representatives to the proposed conference are Great Britain, Russia, and Japan.

The council of the Child-study Society has approached Prof. Karl Pearson, F.R.S., to assist its efforts to advance scientifically our knowledge of child-life. Prof. Pearson has drafted a schedule for studying the factors influencing the social life of the child, which he desires to have filled in by heads of families or by teachers intimate with families. The number in the family need not be large, but particulars of father, mother, and at least two children are required. The schedules are being distributed through branch secretaries of the Child-study Society, but it may be difficult in a short time to secure the number requisite to make the subsequent investigation by Prof. Pearson worth while. The society appeals to members of learned societies and to professional men and women to assist the scheme by applying for a copy of the schedule and filling in the particulars. Copies can be obtained from the secretary of the Child-study Society, London, 90 Buckingham Palace Road, London, S.W.

PROF. SORLEY, in his paper on "The Interpretation of Evolution" communicated to a meeting of the British Academy on the fiftieth anniversary of the publication of the "Origin of Species," drew a distinction between inorganic and organic evolution which appears to belong rather to the material forming the subject of the process than to the process itself. It is perhaps true that, as he says, physiologists are on the whole less satisfied now than formerly with the adequacy of the physico-chemical explanation of vital activities; but they have not all abandoned the idea of gaining a more profound insight than at present into the nature of life, nor do they anticipate that any increase of knowledge will tend to exclude vital phenomena from the domain of natural law. That the history of vital activity is in a true sense teleological may be readily conceded, and it is possible that Prof. Sorley is right in holding that the whole course of evolution can only be interpreted "by means of the conception of conscious purpose." Such contentions, however, belong to a domain which is outside that of science.

MR. BALFOUR'S Romanes lecture, delivered at Oxford on November 24, was couched in his happiest vein of genial scepticism. The chief function of literary and artistic critics in all ages has been, he said, to sweep away the rubbish of their critical predecessors. No standard of æsthetic excellence has been found to be permanent; attempts to find an ethical or religious end to art, though not valueless, are independent of the critical question. It is true that in the present age there is a superficial appearance of unanimity as to what is and what is not a successful work of art, though a man of genius like Matthew Arnold or Ruskin will occasionally kick over the traces; but in the history of artistic criticism this unanimity is not to be found. The great Gothic builders were only restrained by considerations of time and money from demolishing the work of their predecessors. Training and study are undoubtedly sources of subsidiary æsthetic pleasure, but the increase of powers of discrimination may be accompanied by a waning of æsthetic sensibility. Are we not, then, obliged to regard æsthetic emotion as a mere accidental by-product of evolutionary process? No assistance is afforded by the instinctive efforts of the popular philosophy to press morals, religion, utility, or progress into the service, nor can satisfaction be obtained out of the metaphysical treatment of the subject; but there remains the consideration that, besides the class of emotions to which the æsthetic sense belongs, there is another class, practical rather than contemplative, at the head of which are the loftiest feelings—love and devotion—of which human nature is capable. These practical emotions, Mr. Balfour thinks, are recalcitrant at present to any logical or philosophical treatment. Why, then, should we quarrel because we can at present find no adequate philosophy of the æsthetic emotions?

THE eighth International Zoological Congress is to be held at Graz (Austria) on August 15–20, 1910, under the presidency of Prof. Ludwig von Graff. The first general meeting of the congress will be held in the afternoon of August 15 in the great Stephaniensaal of the Steiermärkische Sparkasse, and further similar meetings the next and every morning up to and including August 19. Sectional meetings will be held on each of the four afternoons from August 16–19 in the Natural History Institute of the University. A meeting of the nomenclature committee and the committee for the Concilium Bibliographicum has been arranged for August 16 in the Zoological Institute, and the permanent committee of the congress will meet at the same place on August 17 to consider the place of meeting for 1911. Two lantern lectures will be given during the evenings of August 16 and 17 on "Die Steiermark" (Styria), and "The Austrian Riviera, Bosnia, Herzegovina." In addition to short excursions during the late afternoon of the earlier days of the congress, longer journeys have also been arranged. Among the more ambitious excursions may be mentioned:—to the Erzberg and the Leopoldstein See on August 20, to Triest on August 21, and to Dalmatia by special steamer from August 22–27. A banquet will be given by the congress on August 19 to the honorary members, members, and participants. Not only professional zoologists, but all persons interested in zoology, may take part in the congress, which covers the whole field of biology in the widest sense, including, for instance, palæozoology, hydrography, and marine biology. All inquiries relative to the congress should be sent to the Präsidium des VIII. Internationalen Zoologen-Kongresses, Universitätsplatz 2, Graz (Österreich).

WE have to acknowledge the receipt of a copy of No. 62 of the Hull Museum Publications, in which various additions to that museum are recorded; also of vol. v., No. 2, of the *Museum News*, the first article in which is devoted to an account of an exhibition of mediæval architecture in the Brooklyn Museum.

ACCORDING to the October number of the *Victorian Naturalist*, it is proposed to erect in Sydney a statue or some other appropriate memorial to Sir Joseph Banks, who has been called the "father of Australia." In order to awaken interest in the matter, Mr. J. H. Maiden, the Government botanist of New South Wales, has written a full and elaborate life of Banks, and has generously promised to hand over the profits on the sale of the volume to the memorial fund.

IN discussing a new digger-toad from Manchuria in the September issue of the Proceedings of the Academy of Natural Sciences of Philadelphia, Mr. T. Barbour takes exception to the emendation of the barbarous generic name Kaloula to the more classical Callula. Seeing that the emendation was made by Dr. Günther and accepted by the late Prof. Cope, and subsequently by Mr. Boulenger (in the official British Museum Catalogue), it is surely a little strong to write that "*Callula*, a more recent emendation, has no standing in nomenclature." Günther, Blanford, and Boulenger have all seen fit to amend (or accept amendments of) ill-spelt or ill-formed zoological names, and it scarcely becomes their juniors to say they were not justified in so doing.

IN the first portion of an article on the nuptial habits of the black-cock in Scandinavia and England, published in the November number of the *Zoologist*, Mr. Edmund Selous alludes to certain very definite statements made by a Swedish forester to the effect that these birds are in the habit of making burrows for themselves beneath the snow, in which they remain for considerable periods during severe weather. Although each bird makes its own tunnel, it seems probable that the tunnels may often open into a common chamber, where several black-cock may remain in company for the sake of warmth. The capercaillie, on the other hand, has no need for such shelters—and perhaps food-supplies—as the pine needles which form its food are always obtainable in abundance.

The November number of the *American Naturalist* opens with the first part of an instructive article, by Mr. Newton Miller, on the life-history and habits of the American toad, this article being written to illustrate the proper way of studying common American animals from the point of view of their position as active forces in the economy of nature. After devoting a considerable amount of space to the breeding-habits and development of the species, the author makes the (to us) novel observation that "toads are more numerous in and about towns than elsewhere. Very rarely is a toad seen in a large field under cultivation. Only fifty toads were seen during a whole season on one thousand acres of farming land in central Indiana. This scarcity may be accounted for by two factors, *i.e.*, first that pasturage and tillage kill the toads, or, secondly, that the extensive drainage has exterminated the toad by depriving it of breeding places."

Mutation in Ceratium, a protozoan common to fresh and salt water, forms the subject of No. 13 of vol. lii. of the Bulletin of the Museum of Comparative Zoology at Harvard College. After describing the mutations observed, the author, Mr. C. A. Kofoid, states that the most important fact in the phenomena is the abrupt and complete change in form in a line of descent in a single generation, or at most in two generations, of organisms asexually produced. The change is recorded in fixed skeletal parts which clearly show the transmutation in shape, while the accessory phenomenon of chain-formation enables the line of descent to be accurately traced. These changes do not give rise to new types, "but old well-known types give rise suddenly to others old and well known, or at least previously known. The particular category to which these types are referred, species, subspecies, varieties, or forms, is a subordinate matter. . . . The fact remains that like gives rise to unlike, that the descendants differ profoundly from the ancestral type."

Prof. Hickson and Mr. Wadsworth give an interesting account in the *Quarterly Journal of Microscopical Science* (vol. liv., part ii.) of their observations on *Dendrosoma radians*. This remarkable Acinetarian occurs in abundance on the stems of Cordylophora in the Bridgewater Canal near Altrincham, and supplies were also obtained from Birmingham. The authors give a detailed account of the minute structure of the adult and the formation and development of the ciliated gemmule. They find that the so-called "external buds" described by Saville Kent are really epizoic Acinetarians of the genus Urnula. The phenomena of conjugation have not yet been observed.

The *Quarterly Journal of Microscopical Science* (vol. liv., part ii.) contains a continuation of Mr. Goodrich's well-known researches on the structure of the excretory organs in Amphioxus. Mr. Goodrich brings forward what appears to be very conclusive evidence in favour of his view that the nephridia of Amphioxus do not open, as Boveri has supposed, into the cœlom, but end blindly at their inner extremities. He maintains the homology of these organs with the nephridia of Annelids and Platyhelminths, and not with the kidney tubules of the Craniata, and gives a partial, but very interesting, account of their development. He has examined the sections upon which M. Legros based his conclusions as to the origin of the nephridia from the cœlomic epithelium, but does not agree with this author on this important point. We are left to conclude that the nephridia of Amphioxus are probably ectodermal in origin, although the question is not discussed in detail at present. The paper also deals with the structure known as Hatschek's nephridium, and the discovery of solenocytes in this organ by Goldschmidt is confirmed. It appears to be a true nephridium, homologous with the posterior nephridia, but the fact that it opens into the alimentary canal (externally; it has no internal opening) remains unexplained. We must also direct attention to the valuable criticism of Prof. Hubrecht's views on the early ontogenetic phenomena in mammals, by Mr. Richard Assheton, which concludes the number.

In a pamphlet recently published at Athens under the title of "’Ιωάννης Λαμὰρκ καὶ τὸ ἔργον αὐτοῦ," the author, M. Athanasios E. Tsakalotes, gives a very clear and impartial account of Lamarck's life and work. Passing in brief review the facts and dates of the famous French naturalist's scientific career, he enumerates the various systematic treatises that came from his pen, and enlarges on the evolutionary views which found expression in the "Philosophie Zoologique," published just one hundred years ago. The main points in Lamarck's theory of descent are well brought out—his belief in the continuity of the process, his consequent rejection of Cuvier's theory of successive catastrophes, his doctrine of the inherited effects of use and disuse, and of the direct action of the environment on plants and on the lower animals. The author shows how intimately in Lamarck's mind the facts of adaptation were connected with the problem of evolution; the passage in the "Philosophie Zoologique" on the relation of structure to habit and function in the three-toed sloth might, he asserts, have been written by Darwin himself. That Lamarck's views failed to commend themselves to his scientific contemporaries was, the author thinks, partly his own fault; for the reasons that he was in too great a hurry in reducing his speculations to a complete system, and that he weighted his theory with improbable psychic elements, for example, the alleged influence of individual volition. The author might have added that Lamarck lacked the touch of genius that led Darwin and Wallace to find in natural selection the key to the problem of adaptation.

Mr. Carus-Wilson informs us that he has sent to the Kew Museum the specimen of oak in which stones are embedded, referred to in his recent paper on "The Natural Inclusion of Stones in Woody Tissue," described in Nature of November 25 (p. 117).

The development of the embryo-sac of *Datisca cannabina* forms the subject of an article by Dr. W. Himmelbaur in the *Sitzungsberichte der Kaiserlichen Academie der Wissenschaften*, Vienna (vol. cxviii., part ii.). One division of the embryo-sac mother cell is the rule; otherwise, except for the early disappearance of the antipodal cells, development is normal. The author refutes the possibility of parthenogenesis, but finds that parthenocarpy, *i.e.* the maturation of the fruit without fertilisation of the ovule, may occur.

A study of trichomes as hereditary characters in a few pure and hybrid species of Juglans, Œnothera, Papaver, and Solanum, is described by Dr. W. A. Cannon in Publication No. 117 of the Carnegie Institute of Washington. It is apparent that the trichomes in these cases are not allelomorphs; in fact, they vary in size as much according to their position on the leaves as they do for different species. The development of the hairs on the leaves was also investigated for the species of Juglans, and found to be consistently uniform except in a single type observed in an F_2, or second hybrid generation.

The current number of *Irish Gardening* (November) opens with an account, by the Hon. Vicary Gibbs, of a few of the shrubs collected by Mr. E. H. Wilson during his last visit to China. About forty species of Rubus have been introduced, chiefly on account of their decorative foliage and stem colouring; also a number of new species of Hydrangea, Ribes, and Vitis. New climbers are furnished by the genera Clematis and Lonicera, of which *Clematis Pratti* and *Clematis souleana* receive special mention. A short report is given of a meeting held in Dublin by the Irish Forestry Society with the object of promoting an annual November "Arbor" week; the economic importance of forestry and the former extent of Irish forests formed the subject of addresses. A novel plan is mentioned in a note of etherising the roots of fruit trees to retard the blossom and so save it from being destroyed by spring frosts; the experiment is said to have been successful.

Owing to the custom which prevails so largely in Germany of making presents of plants at Christmas and on other auspicious occasions, there is a great industry in forcing plants, notably lilacs and cyclamen. As a consequence of this unnatural treatment diseases appear, or become more malignant, and in this connection a brochure by Dr. H. Klebahm, dealing with diseases in lilacs, has been recently published. A bacterial disease of the branches or leaves caused by *Pseudomonas Syringae*, and other leaf diseases due to a Heterosporium and Botrytis, are referred to, but the main purpose is to give the details of a new disease, traced after considerable trouble to a Phytophthora. Full details of the life-history, which is similar to that of *Phytophthora omnivora*, have been worked out.

We have received from the Michigan State Agricultural College Experiment Station several bulletins dealing with subjects of practical interest. The construction of silos of wood and of cement is described, the latter material being found especially satisfactory. The number of silos in Michigan is steadily increasing; green maize is generally used, either alone or mixed with field peas, cow peas, or soy beans, &c. A description is given of the methods used in treating pigs for the prevention of hog cholera by injection of the appropriate serum; good results are said to be obtained. Another bulletin deals with the feeding of farm horses during winter time, a highly important economical problem. Several rations are suggested, and the cost is worked out in each case.

The report of the Botanic Station Agricultural School and Experiment Plots, St. Lucia, is a record of continued progress. The soil under cultivation is generally very fertile, and as the population is not large the means of subsistence is easily gained by the natives. In consequence, the methods of cultivation are not very advanced, and there is abundant scope for the work of the agricultural instructors. Attempts are being made to develop the cultivation of Sea Island cotton, and also to assist the sugar industry. Improved methods of dealing with cacao and limes are being worked out, and the various pests submitted to examination. A number of rubber trees and mangoes have been distributed among the planters from the station.

The bird problem in relation to agriculture is discussed in a recent number of the *Journal of Agriculture of South Australia*. Among insectivorous birds recommended to be encouraged are the wrens (*Malurus cyaneus*), the flycatchers (*Rhipidura tricolor*, *Sisura inquieta*, *Micraeca fascinans*), the robin (Petrœca, sp.), the swallows, the thrush (*Collyriocincla harmonica*), the pipit (*Anthus australis*), the catbird (*Pomatorhinus superciliosus*), and the yellow-rumped tit (*Acanthiza chrysorrhoa*). On the other hand, the sparrow and the starling do great damage, and the advisory Board of Agriculture has recommended that stringent methods of dealing with them should be made compulsory.

In continuation of his general discussion on the earthquakes of the Philippines, noticed in Nature of October 28 (vol. lxxxi., p. 527), the Rev. M. Saderro Masó has undertaken the study of the different seismic regions of the archipelago. His first paper deals with the earthquakes of the Batanes Islands, a group in the extreme north, and only about 200 kilometres from Formosa. In the central island of Batan forty-nine earthquakes were recorded in the six years 1903–8, May and June being the months of greatest frequency. None of these shocks exceeded the degree of intensity 5 of the Rossi-Forel scale. Father Saderro Masó discusses the interesting question whether the Batanes Islands are more closely related seismologically with Formosa or Luzon, and, though the evidence is not very complete, concludes in favour of their connection with the latter and more distant island.

Mr. T. Sheppard, the curator of the Hull Museum, continues his useful series of catalogues of the collections under his charge, which are issued at the nominal price of one penny each. The last numbers are devoted to an account of a large collection of Roman antiquities from South Ferriby, in North Lincolnshire, and of a number of Anglo-Saxon vases. These publications are issued in cooperation with the Hull Scientific Field Naturalists' Club, which is doing excellent work in cataloguing the fauna and flora of Yorkshire. The second part of its Proceedings for the current year is largely devoted to an account, by Mr. T. Stainforth, of the spiders, harvestmen, and pseudo-scorpions of East Yorkshire.

The common horseradish (*Cochlearia armoracia*, L.) has been described by Darwin and others as a plant which practically never produces seeds. M. J. Brezezinski contributes to the Bulletin of the Cracow Academy of Sciences, No. 7 (1909), some interesting experiments on this point. He adopted two plans of favouring the production of seeds—grafting and an annular incision round the root. The former plan was a failure, but the latter led to the production of a good number of seeds, some of which germinated and have grown up. These seedling plants belong to two widely differing types, of which illustrations and descriptions are given.

A paper on the decimal system of numbers is contributed to the *Popular Science Monthly* for November by Dr. L. C. Karpinski. It contains a historical account of the Babylonian, Roman, Greek, Hindoo, and Arabic systems. A necessary conclusion is that improvements in the system of numeration have been slow to obtain adoption. Even at the present day France does not possess a decimal system of numeration, the use of 20 as a base being still preserved in numbers above 60, a system which, we are told, is of Semitic origin, and exists also among certain Pacific Coast tribes. It exists also in Wales. As a further illustration, the author refers to the slowness of the United States and England to adopt the metric system.

The principal of the Belfast Municipal Technical Institute has drawn up a valuable series of notes on the method of conducting experiments set in laboratory courses of experimental science. The guidance offered is intended to secure a desirable amount of uniformity in the conduct of the various laboratory classes in the institute. It is, we notice, made clear that the teachers in charge of the laboratories concerned are at liberty to modify the suggested scheme to meet their special needs. The notes should be of assistance to young demonstrators who are gaining experience as indicating what a successful teacher has found to be a good plan of procedure, but any slavish copying of a hard and fast routine would be undesirable in most cases. The notes have been printed for distribution among the staff at Belfast.

THE *Physikalische Zeitschrift* for November 10, and part xx. of the *Berichte der deutschen physikalischen Gesellschaft*, are both devoted to reports of the physical papers read at the Versammlung deutscher Naturforscher held at Salzburg in September. The former periodical gives, in addition, reports of the discussions following the reading of the papers. An afternoon sitting was devoted almost entirely to papers on the problems which arise in the treatment of radiation and in the building up of electrodynamics on the principle of relativity. Prof. Sommerfeld discussed the composition of velocities, and Dr. M. Born the dynamics of electrons on the theory of relativity. Prof. Einstein gave an interesting account of the development of our views of the origin and constitution of radiation, an account which will be of special value to those who are looking forward to the appearance of Sir Joseph Larmor's recent Bakerian lecture.

MESSRS. ELLIOT BROTHERS are making an accelerometer and gradient measurer, devised by Mr. H. E. Wimperis, which is both ingenious and simple and is free from disturbance by motions of any kind, except that of acceleration in one direction or of tilting in the same direction. Two vertical spindles are geared together so as to run in opposite directions, and they are each eccentrically weighted, and the weights are so placed that their motions in the direction marked upon the instrument are the same and conspire in their effect, while those transverse to this direction are opposite and neutralise each other's effect. One of the spindles carries a copper disc damped by a permanent magnet, an index moving over the scales of acceleration and gradient, and a controlling hair-spring. Such a combination is unaffected by rotational movement or by rotational acceleration of the instrument about any axis whatever; it is also unaffected by transverse or vertical motion or acceleration, or by longitudinal steady motion. It is therefore affected by longitudinal acceleration or by fore and aft gradient alone. As either fore and aft tilting and fore and aft acceleration are of necessity both operative, it is impossible merely by taking a reading to tell how much of the deflection is due to each if the two causes act simultaneously. The user is therefore instructed how to arrange that one of the effects is zero, or, if they both act together, to determine one by an independent observation. A large number of illustrations of the utility of the instrument are described, including power of engine, efficiency of brakes, friction when running idle, and measurement of gradients.

WE have received the first part of Dr. Ludwig Koch's "Pharmakognostischer Atlas" (Leipzig: Gebruder Borntraeger), which is intended to form a supplement to the recently completed work by the same author on the microscopical analysis of drug powders. The atlas will deal mainly with the crude drugs of the German Pharmacopœia, and will contain illustrations and descriptions of sections cut in various directions, the illustrations being sufficiently extensive to show, not only the nature of the elements that occur, but also their relative quantity. Judging from the first part, the figures, so important in a work treating of structural details, will leave nothing to be desired in clearness or accuracy, and the descriptions, though minutely detailed, will be readily intelligible. The work promises to be one of the most valuable of its kind, and to be indispensable to everyone interested in the anatomical structure of drugs.

MESSRS. J. J. GRIFFIN AND SONS have issued their list of chemicals manufactured by C. A. F. Kahlbaum, of Berlin. In comparison with their previous list there has been an expansion from 79 to 95 pages. As compared with the German price-lists of Kahlbaum and Schuchardt, the present list shows an increase of price amounting, in the case of typical materials, to about 35 per cent., but as the English prices include cost of freight, bottles, and packing, the difference on small orders is not excessive, and there can be no difference of opinion as to the advantages gained by having a stock of these materials available in London for immediate use.

THE Journal of the Chemical Society for October contains an interesting paper by Mr. R. W. Gray and Mr. F. P. Burt on the atomic weight of chlorine. The work is divided into three parts—a revision of the density of hydrogen chloride, a re-determination of its volumetric composition, and a study of its compressibility at 0° between the limits 780 mm. and 150 mm. The density was measured by an ingenious application of the condensing action of charcoal cooled by liquid air, as suggested and used by Dewar and Jones. The gas to be examined was condensed by liquid air, carefully purified by fractional distillation, and transferred for measurement of volume to a flask of 460 c.c. capacity surrounded by ice and distilled water, and connected to a manometer; for measurement of weight it was connected to a charcoal bulb having a capacity of only about 20 c.c.; when cooled with liquid air the charcoal absorbed the whole of the hydrogen chloride, leaving a vacuum both in the weighing and measuring bulbs, and by closing the bulb by a stop-cock its weight could be determined at atmospheric temperatures. The average density, after correcting for adsorption of gas by the walls of the measuring bulb, was found to be 1·63915 grams per litre. The volumetric analysis, carried out by measuring the volume of hydrogen set free by the action of aluminium on the gas, gave a mean volume of 1·00790 vols. hydrogen from 2 vols. hydrogen chloride. Combined with Morley's value for the density of hydrogen, the authors' own value for the density of hydrogen chloride, and Morley's value for the ratio of oxygen to hydrogen, this gave the atomic weight 35·459. A comparison of the densities of hydrogen chloride and oxygen, both corrected for deviations from Boyle's law, gave $Cl=35·461$. The mean value $Cl=35·460$ coincides exactly with the mean of seven recent determinations ranging from 35·452 to 35·466, and there can be little doubt that the figure is substantially correct.

THE firm of Gauthier-Villars, of Paris, has published the first of a series of volumes projected under the general title "Savants du Jour." The present book deals very appropriately with M. Henri Poincaré, whose work is known to men of science everywhere. The frontispiece to the volume is an admirable portrait of M. Poincaré. The text is divided into seven sections; the first is in the form of a biography, which comprises the discourse by M. Frédéric Masson last January in response to an oration by M. Poincaré when received by the Académie Française, a chronological list of the distinctions conferred upon the subject of the work, and a list of the appreciative articles upon his career which appeared in the French Press. The succeeding six sections are concerned, respectively, with

M. Poincaré's works in mathematical analysis, analytical and celestial mechanics, mathematical physics, and scientific philosophy; his obituary notices of numerous men of science, including the late Lord Kelvin; and his more various writings. Each of the sections dealing with M. Poincaré's scientific work is prefaced by an appreciation by some great authority; thus, that on celestial mechanics is preceded by a translation of Sir George Darwin's address in presenting the gold medal of our Royal Astronomical Society last February. The price of this interesting volume is 7 francs.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN DECEMBER:—

Dec. 2. 6h. Venus at greatest elongation, 47° 18′ E.
,, 18h. Mercury in superior conjunction with the Sun.
6. 10h. 35m. Jupiter in conjunction with the Moon (Jupiter 3° 35′ S.).
12. 7h. 45m. Sun eclipsed, invisible at Greenwich.
,, 19h. 27m. Mercury in conjunction with the Moon (Mercury 0° 3′ S.).
14. 13h. 51m. Uranus in conjunction with the Moon (Uranus 3° 5′ N.).
16. 3h. 10m. Venus in conjunction with the Moon (Venus 2° 50′ N.).
18. 9h. Mercury in conjunction with λ Sagittarii (Mercury 0° 3′ N.).
20. 10h. Saturn stationary.
,, 11h. 56m. Mars in conjunction with the Moon (Mars 5° 0′ N.).
,, 21h. 2m. Saturn in conjunction with the Moon (Saturn 1° 40′ N.).
27. 8h. 30m. Neptune in conjunction with the Moon (Neptune 4° 9′ S.).
,, 20h. 1m. Mercury in conjunction with Uranus (Mercury 1° 43′ S.).

HALLEY'S COMET, 1909*c*.—The following is a further extract from Mr. Crommelin's revised ephemeris for Halley's comet as given in No. 4359 of the *Astronomische Nachrichten*:—

Ephemeris.

1909 (Berlin M.T.)	R.A. (1910·0) h. m.	Decl. (1910·0) ° ′	log *r*	log Δ	Magnitude
Dec. 1·4	4 26·9	+15 52			
6·4	4 6·2	+15 23	0·3775	0·1505	12·4
11·4	3 44·4	+14 45			
16·4	3 22·3	+14 4	0·3527	0·1340	12·0
21·4	3 0·6	+13 18			
26·4	2 40·2	+12 28	0·3259	0·1381	11·8

From this we see that the comet is now a little to the west, and south of, Aldebaran, and on December 4 will pass very near to γ Tauri.

According to a note by Mrs. Maunder in the *Daily Chronicle*, Mr. Hollis found the comet a conspicuous object in a 10-inch telescope on November 22, and the Rev. T. E. R. Phillips observed it the same evening, and was still able to see it when the aperture was reduced to 3 inches. Photographs taken at Greenwich on that date showed the comet to be somewhat brighter than the tenth magnitude, *i.e.* about eight times as bright as computed.

OBSERVATIONS OF MARS.—Seven new canals, bringing the total found at the Hem Observatory up to twenty-three, are announced by Mr. Jonckheere in No. 4371 of the *Astronomische Nachrichten*. For two of them, leaving the Cyclopum Lucus and going to Hephæstus and Amenthes respectively, Mr. Jonckheere proposes the names Cepheus and Cassiopeia.

The *Comptes rendus* for November 15 (No. 20) contains three notes dealing with the planet. In the first M. Idrac describes the visual and photographic observations made by him at Meudon during the recent opposition. The photographs were taken in the focus of the 24-inch photographic equatorial, and show a fair number of details, some of which were not visible, or very faint, to the naked eye; the plates used were sensitive to the blue and ultra-violet radiations. On September 20 the edge of the north polar cap was shown clearly on the photograph, and on September 25 extended down to about latitude 55°.

In the second note M. Antoniadi describes the results of thirteen nights' observations made between September 20 and November 9. The most remarkable changes, since the opposition of 1907, appear to be the return of Syrtis Major to the form it had in 1864 and 1877, the re-apparition of Lac Mœris, and the formation of a multiple "island" in the eastern part of the Mare Cimmerium. About fifty "canals" were seen, but M. Antoniadi discusses the meaning of this term before applying it definitely to the features seen. He defines eight types of markings which may be called "canals," and finds that there is no geometrical *réseau* of straight lines intercrossing on the surface of Mars; but across the continental areas there is a structure like a grey marbling, which is too evanescent and intricate to be drawn. A useful chart (Mercator) accompanying the note embodies the features seen at Meudon.

MM. de la Baume Pluvinel and F. Baldet contribute the third note, which describes the photographic researches carried out on the Pic du Midi during September and October. Ordinary plates were used at first, with exposures of 0·1s., but these showed only the polar caps. Later exposures, with Lumière colour filters and various bathed plates, took 6s. to 12s., and show nearly all the details observed visually; the geometrical *réseaux* of fine canals are not, however, to be found on the photographs.

During the recent opposition, M. Kostinsky, using the Pulkowa astrographic telescope, succeeded in obtaining photographs of the two satellites Phobos and Deimos, and now publishes the measures in No. 4369 of the *Astronomische Nachrichten*. The accordance with the ephemeris (based on Struve's elements) is satisfactory, and the photographic magnitudes of the satellites are 11·6 and 12·3 respectively.

PERRINE'S COMET, 1909*b*.—An observation of Perrine's comet, made at Heidelberg on November 20, gave the position at 13h. 0·2m. (Königstuhl M.T.) as 7h. 6m. 20·33s., +15° 31′ 28″ (1909·0), and the magnitude as 14·0 (*Astronomische Nachrichten*, No. 4371).

In No. 4369 of the *Astronomische Nachrichten* Prof. Wolf directs attention to an abnormal decline of the brightness of this object about November 9. On October 11 it was seen with difficulty in the reflector, and on November 6 could not be found visually, although since September 5 it has been observed visually with a 6-inch telescope. A photograph taken with the Bruce telescope on November 9 failed to show any trace of the comet, which must therefore have become enormously fainter.

THE DESIGN OF SPECTROGRAPHS.—All those who are interested in the design and performance of spectrographs, more especially such as are used for radial-velocity determinations, will welcome a paper by Mr. J. Plaskett which appears in No. 4, vol. iii., of the Journal of the Royal Astronomical Society of Canada. As is now generally known, Mr. Plaskett has, since 1905, devoted a great deal of labour to the design of a generally effective instrument, and he has now succeeded in producing a single-prism spectrograph which has proved beautifully effective. Rigidity, temperature control, and optical efficiency have all been provided for, and the instrument can be changed from a one- to a three-prism spectrograph in two minutes without affecting the temperature conditions. Mr. Plaskett gives illustrations and full details of the numerous minor devices and accessories, which it is impossible to reproduce here.

THE ASTRONOMICAL SOCIETY OF WALES.—No. 3, vol. xi., of the *Cambrian Natural Observer*, the quarterly record of the Astronomical Society of Wales, contains several useful notes for amateur observers. Miss Hagerty contributes an interesting article on solar energy, and Mr. Mee asks all Welsh observers to forward to him accounts of any astronomical phenomena they may observe; he gives some useful hints as to what the naked-eye observer may see and should record.

BRITISH ASTRONOMICAL ASSOCIATION.—Messrs. Neill and Co., Edinburgh, have just published, for the British Astronomical Association, a general index of the Journal from vol. i. to vol. xviii. The index has been compiled by Mr. F. W. Levander.

RESEARCHES IN RADIO-TELEGRAPHY.[1]

RADIO-TELEGRAPHY, popularly called wireless telegraphy, has outlived the tentative achievements of its precocious infancy and obtained for itself a settled but important position amongst our means of communication.

This stage, however, has only been reached after a long struggle with experimental difficulties and much labour in analysing the processes involved. As many of these matters are of general scientific interest, it is proposed, during the present hour, briefly to summarise the results of some recent research.

It is well known that the nature of the earth's soil or surface between the sending and receiving stations has a great effect upon electric waves passing over it. If the surface is a very good conductor the wave hardly penetrates into it, but glides over the surface. If it is a poor conductor the wave penetrates into it to a greater extent, and the worse the conductivity the deeper the penetration.

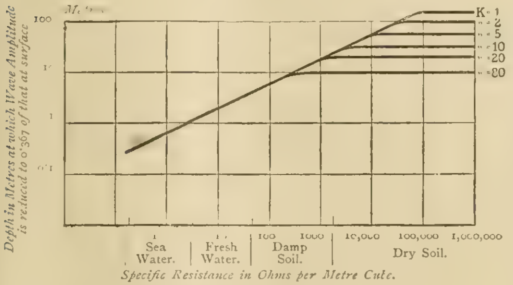


FIG. 1.—Depth of Penetration of Waves 1000 feet in length. (Dr. Zenneck.)

The materials of which the earth's crust is composed, with some exceptions, owe their electric conductivity chiefly to the presence of water in them. They are called electrolytic conductors. Substances like marble and slate, when free from iron oxide, are fairly good insulators. Dry sand or hard dry rocks are poor conductors, but wet sand and moist earth are fairly good conductors. Sea water, owing to the salt in it, is a much better conductor than fresh water. The following table gives some figures, which, however, are only approximate, for the specific resistance of various terrestrial materials in ohms per metre cube. It will be seen that dry sand or soils are of very high specific resistance, and damp or wet sand or clay fairly low.

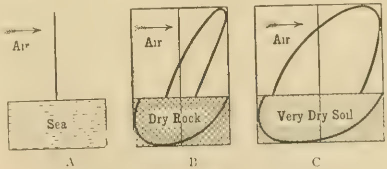
TABLE I.—*Approximate Conductivity and Dielectric Constant of various Terrestrial Materials.*

Material	Specific resistance in ohms per metre cube	Dielectric constant. Air = 1
Sea water	1	... 80
Fresh water... ...	100 to 1000	... 80
Moist earth... ...	10 to 1000	... 5 to 15
Dry earth	10,000 and upwards	... 2 to 6
Wet sand	1 to 1000	... 9
Dry river sand ...	very large	... 2 to 3
Wet clay	10 to 100	... —
Dry clay	10,000 and upwards	... 2 to 5
Slate	10,000 to 100,000	... —
Marble	5,000,000	.. 6
Mercury	0·000001	... infinity

If our earth's surface had a conductivity equal, say, to that of copper, then the electric radiation from an antenna would glide over the surface without penetration. In the case of the actual earth there is, however, considerable penetration of the wave into the surface, and therefore absorption of energy by it.

Brylinski, and also Zenneck, have calculated the depth to which electric waves of such frequency as are used in radio-telegraphy penetrate into the sea or terrestrial strata of various conductivities. For mathematical reasons, it is customary to define it by stating the depth in metres or centimetres at which the wave amplitude is reduced to $1/\epsilon = 0{\cdot}367$ of its amplitude at the surface. I have represented in a diagram some of Zenneck's results calculated for waves of 1000 feet in length, and for terrestrial surface materials of various kinds, conductivities, and dielectric constants (see Fig. 1). You will see that in the case of sea water an electric wave travelling over it penetrates only to the depth of a metre or two, whereas in the case of very dry soil it would penetrate much deeper. Owing to the conductivity of the soil, this movement of lines of magnetic force through it sets up currents of electricity which expend their energy in heat. This energy must come from the original store imparted to the sending antenna, and therefore the wave is robbed of its energy as it travels over the surface.

Dr. Zenneck has discussed mathematically, in a very interesting paper, the effect of the conductivity and dielectric constant of the terrestrial surface, soil or sea, on the propagation of a plain electric wave over it, assuming the radiation to be from an ordinary vertical antenna, and the electric force therefore normal to the earth, and magnetic force parallel to it. The result is to show that there are, broadly speaking, three cases to consider. First, supposing the surface material to be a good conductor, then the wave moves over the surface and penetrates a very little way into it. The electric force in the air over the surface is a purely alternating force vertical to the earth's surface, and the magnetic force is an alternating force parallel to it, and there is very little subterranean electric or magnetic force (Fig. 2, A). This is realised approximately or most nearly in the case of radio-telegraphy over sea water. Secondly, let the earth be assumed to have a very poor conductivity and not a very large dielectric constant, then analysis shows that the electric force in the air has two components, one perpendicular to the earth's surface and one parallel to it, and the resultant is an alternating and a rotating force, the direction of its maximum value being inclined to the surface and leaning forward (Fig. 2, B). The wave-front therefore slopes forward. Also there is a subterranean electric force, showing that the wave is penetrating into the soil, and there is therefore dissipation of energy owing to the conductivity of the soil as the wave travels over the surface. This case is realised when the wave travels over land composed of dry soil having a small dielectric constant. Thirdly, let the earth be a very poor conductor, having a small dielectric constant from 2 to 3, and a specific resistance of about 10,000 ohms per metre cube. For example, very dry earth or sand. Then the investigation shows that the electric force in the air has two components, one parallel to the earth's surface and one perpendicular to it differing in phase, and the resultant is represented by the rotating radius of an ellipse, the maximum value or major axis of which is inclined forward in the direction of the wave motion (Fig. 2, C). At the



$r=1$ ohm per metre cube. $K=80$.

$r=100{,}000$ ohms per metre cube. $K=2-3$.

$r=10{,}000$ ohms per metre cube. $K=1-3$.

r = Resistivity. K = Dielectric constant.

FIG. 2.

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[1] From a discourse delivered at the Royal Institution, on Friday, June 4, by Prof. J. A. Fleming, F.R.S.

same time there is some penetration of the wave into the earth, and consequent dissipation of energy.

Dr. Zenneck has considered the case of electric waves 1000 feet in wave-length, and has represented the final result by some interesting curves. He defines the effect of the absorption of energy by the soil by stating the distance in kilometres at which the wave amplitude would be reduced by the effect of this absorption to $0{\cdot}367 = 1/\epsilon$ of its amplitude at the sending station, altogether apart from the weakening due to the spreading of the waves out in a hemisphere, which we may call the spherical or space decrease. These curves are plotted to abscissæ representing the specific resistance of the soil (Fig. 3). You will see from this diagram that when a plane electric wave having the above wave-length is propagated over sea water, it would have to travel 10,000 kilometres before its amplitude would be reduced in the assigned ratio, and over fairly dry soil about 100 to 1000 kilometres; but over very dry soil, having a small dielectric constant, only about 1 to 10 kilometres. Also you will notice that the curves rise up again for still higher resistivities. This, of course, is as it should be. All the practical cases lie between two ideal extremes: the case of an infinitely perfectly conducting earth, in which case the waves would not penetrate into it at all, and the other case, an infinitely perfect non-conducting earth, in which the wave would penetrate into it, but would suffer no dissipation of energy. This theory is quite in accordance with practical experience in radio-telegraphy. Every receiving apparatus associated with an antenna of a certain height and kind must be subjected to waves of a certain minimum amplitude to give any appreciable signal. For all lower amplitudes that particular receiving arrangement is perfectly deaf. Now it is a matter of common experience that with a given radio-telegraphic apparatus and antenna it is possible to receive signals for greater distances over sea water than over dry land, and that if the soil is very dry the distance may be cut down very considerably indeed. This is not due merely to the difficulty of making what the telegraphists call a good earth at the sending station, it is due to the absorption of the wave by the earth for the whole distance which extends between the two stations. Hence, also, it is a common experience that when particularly dry weather is succeeded by wet weather the radio-telegraphic communication between two stations on land is considerably improved.

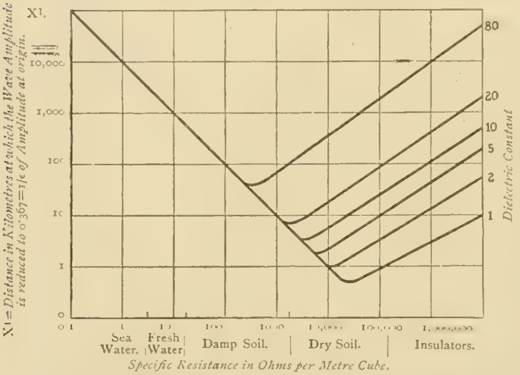


FIG. 3.—Curves showing the Distance in which Electric Waves 1000 feet (300 metres) in length have Amplitude reduced to $1/\epsilon$ by travelling over various surfaces. (Dr. Zenneck.)

The next point in connection with the antenna to be noticed is the means adopted of setting up the oscillations in it. The universal custom at present is to excite oscillations in a reservoir circuit consisting of a condenser and an inductance by means of the spark or arc. If the spark method is used, then the condenser is one of relatively large capacity, and the inductance is kept small. If the capacity is measured in electrostatic units, and the inductance in electromagnetic units, the ratio of capacity to inductance may be something of the order of 5/1 or even 20/1. In this case the condenser is charged by means of an induction coil or transformer, and discharged across a spark-gap, and this discharge consists of intermittent trains of electric oscillations with a periodic time equal to the free natural period of the oscillatory circuit. These discharges are made to succeed each other from 50 to 600 times a second by using an induction coil with an appropriate interrupter, or else an alternator and a transformer. If the arc method of exciting the oscillations is employed, then the ratio of capacity to inductance must be much smaller, and the oscillations are excited in this circuit by a continuous current arc worked with a voltage from 200 to 400 volts or more, the arc being traversed by a strong magnetic field, and generally being placed in a chamber kept free from oxygen. The oscillations set up in the condenser circuit are then persistent or unbroken. The oscillations are excited in the antenna by coupling it inductively or directly with the condenser circuit (Fig. 4). If the former method is employed, then an oscillation transformer is used consisting of two coils of wire, one coil being inserted in the condenser circuit and one in the antenna circuit, and according as these coils are near or far apart they are said to be closely or loosely coupled. These two circuits have, then, each their own natural period of electric vibration, like tuning-forks, and they have to be adjusted to syntony. It is well known that under these conditions oscillations set up in one circuit immediately create oscillations of two frequencies in both circuits. This action can be easily illustrated by two pendulums, which are of the same length and are hung side by side on a loose string distinguished by red and blue bobs. If one pendulum is set swinging it imparts little jerks to the other and sets the latter in motion, but to do this the first must part with its own energy, and hence is gradually brought to rest. Then the operation is repeated in the reverse direction. The motion of each pendulum may then be represented by the ordinates of a curve such as those in Fig. 5. This kind of motion can,

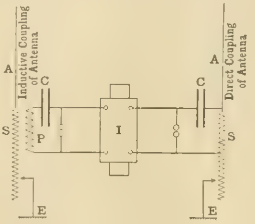
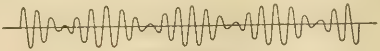
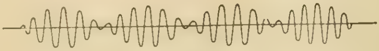


FIG. 4.



Red Pendulum



Blue Pendulum

FIG 5.

by a well-known theorem, be resolved into the sum of two oscillations of different frequencies. Hence each pendulum may be said to possess two rates of vibration. The same thing happens in the case of two closely coupled syntonic electric currents. If one circuit has free oscillations set up in it, the action and reaction of the circuits generates oscillations of two frequencies. Accordingly, when an antenna circuit is coupled to a condenser circuit we have oscillations of two frequencies set up in it, and waves of two wave-lengths radiated from the antenna. The presence of these two waves can be detected either by measurements made with the cymometer or by an oscillograph vacuum tube. In the first case, all that is necessary is to place a cymometer in proximity to the antenna and vary its oscillation constant. It will be found that there are two settings of the handle for which the neon tube glows brightly, and the scale of the instrument will indicate the wave-lengths of the two waves respectively.

Some instructive measurements of this kind have been made by Prof. W. G. Pierce in a recent research, and he has shown that the wave-length given by the formulæ which can be deduced from the theory of the operations are in agreement with actual measurements (Fig. 6). Another striking confirmation can be obtained by the oscillograph vacuum tube, invented by Dr. Gehrcke, of the Reichsanstalt, Berlin. This consists of a glass tube having two strip electrodes in it nearly touching, which are made of nickel or aluminium. The tube is filled with pure nitrogen and exhausted to a pressure of about 10 to 20 mm. If such a tube has a high voltage applied to its terminals a glow light extends along the electrodes, the length of which varies with the electromotive force. Hence, if the tube is connected to a circuit in which an oscillatory discharge is taking place, the glow light along the tube will rapidly extend and contract. If the electrodes are examined in a revolving mirror, making from fifty to a hundred turns a second, the images of the glowing electrodes corresponding to each oscillation will be separated out, and if the oscillations are persistent or undamped we see a series of short bright lines alternately above and below a central line. If, however, the oscillations are damped, then we see in the mirror a train of images each decreasing in length (Fig. 7). On applying such an oscillograph vacuum tube to the circuit of an inductively coupled antenna, and examining in a revolving mirror the image of the electrodes, they will be seen to present an appearance as in Fig. 8, taken from photographs kindly given me by Herr Hans Boas, of Berlin. These oscillograms indicate that there are two oscillations present of different frequency, producing an effect similar to beats in music. Owing to the difference in frequency, the oscillations alternately reinforce and extinguish each other throughout the period, and as this type of oscillogram is only obtained with an inductively coupled antenna, it is a proof that in such a case there are two oscillations present of different frequencies. A similar result has been obtained by Prof. E. Taylor-Jones with low-frequency oscillations in coupled inductive circuits by means of an electrostatic oscillogram of his own invention. Looking at these photographs, it will be seen that each represents a single train of damped oscillations gradually dying away, but that in each train of oscillations there is an alternate waxing and waning of the amplitude, which indicates that it may be considered to be composed of two superimposed oscillations of different frequency (Fig. 9).

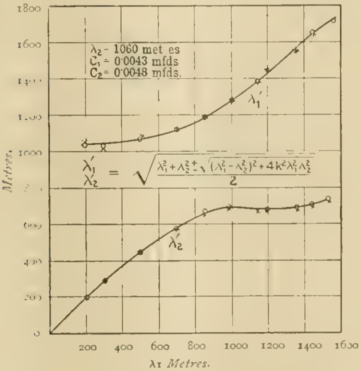


FIG. 6.—Pierce's Experiments on Inductive Coupling.

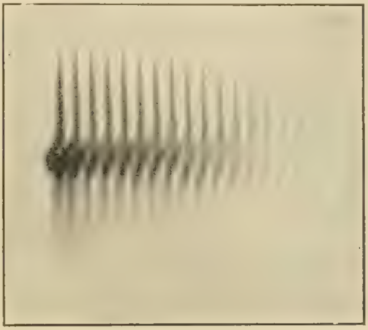


FIG. 7.—Oscillogram of Damped Oscillation (Antenna not connected) taken with the Gehrcke Oscillograph Vacuum Tube.

Accordingly, in the case of wireless telegraph antennæ inductively coupled, we have in general two waves radiated of different lengths, and either of these can be made to affect suitably tuned receiving circuits. These waves have different damping and different maximum amplitudes.

One of the disadvantages of close inductive coupling is, therefore, that we must divide the energy given to the antenna between two waves of different length. As the receiving antenna is generally only tuned to one of these wave-lengths, we then capture and absorb only the energy conveyed by the waves of that wave-length. To meet this difficulty it has been the custom to employ a feeble coupling between the circuits of the oscillation transformer, so as to generate waves of only one wave-length. The objection then arises that the energy conveyed to the antenna is

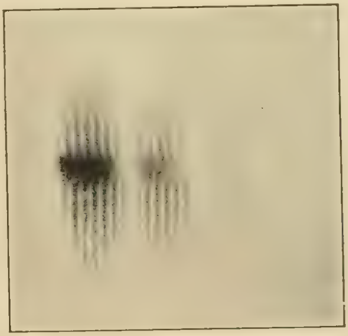


FIG. 8.—Oscillogram of Secondary Oscillation (Antenna connected) taken with Gehrcke Vacuum Tube.

much reduced. It is, however, possible, as I have shown, to duplicate the receiving circuits so as to capture the energy of both the waves even with close coupling of the transmitter transformer[1] (Fig. 10).

A method of creating feebly damped oscillations has, on the other hand, recently been developed, generally known in Germany as Wien's method, or the method of quenched sparks, which is based on the fact that if we can quench or stop the spark in the condenser circuit after the first few oscillations, the oscillations of the antenna then take place freely and with a single frequency (Fig. 11).

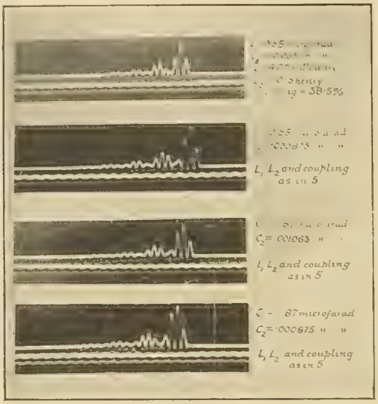


FIG. 9.—Oscillograms of Oscillations in Coupled Circuits by Prof. E. Taylor-Jones.

The principle which underlies this method is the well-known fact, to which particular attention was directed by Prof. M. Wien, of Danzig, in 1906, that the damping effect of very short sparks is extremely large. Hence if we form a spark-gap consisting of a large number of very small spark gaps in series, say ten gaps each of 0·3 mm., and if we keep the spark surfaces cool, then not only can no arc form between these surfaces, but the condenser spark is immediately quenched. Moreover, if we supply this spark-gap either from a high-frequency alternator or from a low-pressure transformer we can produce as many as 2000 sparks per second. A form of discharger for this purpose has been devised in Germany, which consists of a series of copper discs or copper boxes cooled with water, the flat surfaces of which are placed in contiguity, but separated by very thin rings of mica. The interspace between the boxes is not more than 1/125th part of an inch, and ten or twelve of these discs or boxes are placed in series (Fig. 12). The row of boxes takes the place of the ordinary spark balls, and is connected to the secondary terminals of a transformer, fed by a high-frequency alternator, and also connected to an oscillatory circuit. When the transformer is in action it produces a very large number, 1000 or more, oscillatory discharges of the condenser per second, each of which has a large initial amplitude, but quickly dies out. The inductively or directly coupled antenna hence receives a very large number of impulses per second, each of which sets up in it free electrical oscillations of one definite period.

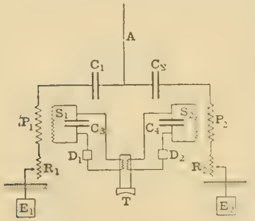


FIG. 10.—Method of utilising waves of both frequencies emitted by inductively-coupled Transmitting Antenna.

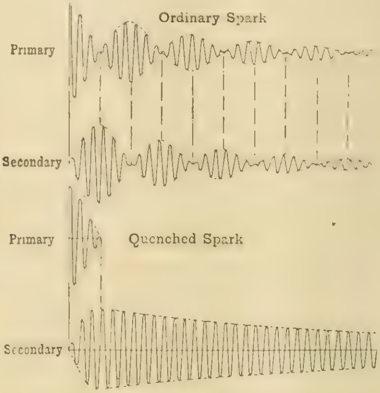
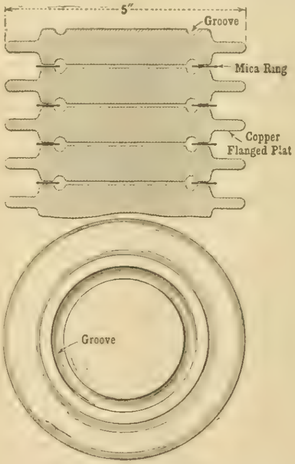


FIG. 11.—Oscillations in Inductively-coupled Circuits.

A discharger, composed of a single pair of metal plates with interposed separating paper ring, has been devised and employed by Von Lepel. In this case the plates are connected to the terminals of a high-voltage direct-current dynamo, and are shunted by a circuit having inductance and capacity, one of the plates being also connected to an antenna and the other to a balancing capacity.



Plan of Copper Flanged Plate.

FIG. 12.—Plan and Section showing portion of Discharger.

These discharges, however, have not stood the test of prolonged practical use, and we cannot say, therefore, that they are comparable in value for telegraphic purposes with the well-proved inventions of Mr. Marconi.

(To be continued.)

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[1] Since the delivery of this lecture, my attention has been drawn by Mr. J. Hettinger to an article by himself in the *Electrical Engineer* of October 26, 1906, in which he describes an almost identical arrangement devised by him for capturing both the waves of an inductively-coupled transmitter, and refers to a prior invention for the same purpose by Dr. Seibt.

TWO REPORTS ON MARINE INVESTIGATIONS.[1]

THE staff responsible for scientific investigations and administration of fisheries under the Department of Agriculture and Technical Instruction for Ireland is attacking its problems with insight and energy, and is laying up a store of information of permanent value and interest. It is somewhat startling at this stage to note that Mr. Holt finds it necessary in his report on international investigations to expound the wherefore of hydrographical and plankton investigations and their bearing upon practical fishery problems. He states the case clearly and well, pointing out the necessity of studying the variations in the "annual ocean tide," of investigating the relation between salinity and plankton distribution, and of determining how far plankton conditions the abundance or absence of pelagic fishes, and hence may be taken as a guide in practical fishery pursuits. The ultimate end is the foretelling of physical conditions—favourable or unfavourable—from knowledge of prior causative factors, and thus preventing blindly tentative and unremunerative fishing operations. This research is of primary importance to Ireland, the staple fisheries of which are for the pelagic and plankton-eating mackerel and herring. The report further deals with the trawling survey of the deep-water grounds off the south-west coast, with mackerel and herring fisheries, oyster and other bivalve fisheries, and their artificial culture by the Department.

In connection with inland fisheries, a valuable fund of information is afforded by the publication of a summary of reports from many different local observers as to the migrations, abundance, and condition of salmon, grilse, and smolts. Local observations relating to the movements of eel fry up the Irish rivers are similarly collated.

Among the papers comprising the appendix is a second report on the Copepoda of the Irish Atlantic slope, by Mr. G. P. Farran, which deals with a total of 164 species, thirty of them being new and three being made types of new genera. The same naturalist writes on the distribution of the Thaliacea and Pyrosoma in Irish waters, discussing their occurrence in relation to hydrographical factors.

In collaboration with Mr. L. W. Byrne, the scientific adviser to the Department contributes a second report on the fishes of the Irish Atlantic slope, containing detailed descriptions and figures of Scorpænidæ and Alepocephalidæ, and a further list of recent additions to the British-Irish fish fauna. Two further appendices are the result of pioneer work under the auspices of the Ulster Fisheries and Biological Association: one by Mr. Geo. C. Gough on the bottom deposits of Larne Lough, and the other by Mr. H. J. Buchanan-Wollaston on the simple ascidians of the Larne district.

The volume on marine investigations in South Africa is a continuation of the reports on South African marine biology published by the Cape Department of Agriculture under the editorship of Dr. J. D. F. Gilchrist, Government biologist of the colony. Various groups of marine animals containing several new species of great interest form the subject of eight papers written by authorities, and well illustrated with thirty-five plates. Dr. Gilchrist's paper on new South African fishes adds to our knowledge of the deep-water forms two genera of Zeidæ and a new species of a genus already described for these waters, viz. Cyttosoma, which may be the adult of Cuvier and Valencienne's Oreosoma. A third new genus and five new species from the same locality are also described. Among notes on other deep-sea forms, perhaps the most interesting observations are in reference to sexual dimorphism in *Scopelus coccoi*, the males of which bear luminous scales on the upper side of the caudal region and the females on the lower side of it. Of shallow-water forms new species are described in the families of Scorpænidæ, Mugilidæ, Pleuronectidæ, and Clupeidæ. The Pelecypoda are dealt with by Mr. G. B. Sowerby, who describes thirty-three species new to science. A continuation of the report on Crustacea, by the Rev. Thos. R. R. Stebbing, contains accounts of further species—some showing remarkable characters as regards pigmentation and luminous organs—of Macrura, Brachyura, Schizopoda, and the interesting parasitic copepod *Penella orthagorisci*. Mr. P. T. Cleve adds to his plankton contributions a report on the Halocypridæ, Cypridinæ, and pelagic Annelida and Chætognatha. A new Cephalodiscus is described in minute detail by Dr. W. G. Ridewood, who includes in his paper a key to the identification of the seven species of this genus now known. A short paper by Prof. F. Jeffrey Bell describing three new crinoids is marred by three different renderings of the specific name of a new Antedon (presumably *A. magnicirra*). Still a fourth variation of spelling appears in the index!

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[1] Report on the Sea and Inland Fisheries of Ireland for 1906. Part ii., Scientific Investigations. Pp. xiv+274. [Cd. 4405.] (1909.)
Marine Investigations in South Africa. Vol. iv. Pp. 196. (Cape Town, 1908.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The syndicate appointed to consider the steps to be taken for the erection of a building for the Department of Agriculture reports that the erection of the building is now practically completed, and the fittings sanctioned are in a forward state. The syndicate anticipates that the building will be ready for occupation by the department at the beginning of the Lent term of 1910.

At a Congregation to be held on Thursday, December 9, at 2 p.m., it is proposed to confer the degree of Doctor of Science, *honoris causa*, upon Mark Aurel Stein.

A short address will be given at the Cavendish Laboratory on Monday, December 6, at 5 p.m., by Mr. G. F. C. Searle, on a course of experimental lectures on geometrical optics specially designed for candidates for the mathematical tripos, which has been arranged for the Lent term, 1910. A number of experiments, with very simple apparatus, illustrating the principles of geometrical optics will be shown. The attendance of mathematical teachers and others interested in the subject is invited.

MR. B. N. WALE, senior lecturer in agriculture at the South-eastern Agricultural College, Wye, has been appointed principal of the Seale-Hayne Agricultural College in Devonshire.

THE London University College Committee will shortly proceed to appoint a Derby scholar in zoology. The value of the scholarship is 60*l.* per annum, tenable for two years. Candidates must have been students of University College in zoology. Full particulars can be obtained from the secretary.

THE Lord Mayor has arranged a conference at the Mansion House on December 3, at 3 p.m., for the discussion of the question of industrial training in education, the development of trade schools, the position of apprenticeship and of the apprenticeship charities, and the establishment of employment bureaux to bring children leaving school into touch with employers of labour. The chairman and members of the London County Council are expected to be present.

A SUMMARY of the returns made to the Education Committee of the London County Council of attendances for the four weeks ended October 30 last at the polytechnics, technical institutes, and schools of art aided by the Council gives some striking results. The returns deal with ten polytechnics and twenty other institutions. In the polytechnics by October 30 last 20,820 individual students were enrolled since the beginning of the session, as compared with 26,410 in attendance for February last. The average number of student attendances a week was, for October, 61,158, and for February, 51,919. In the technical institutes and schools of art together, the grand total of individual students enrolled since the beginning of the session was, for October, 28,558, and for February, 35,911; the average number of student attendances a week were 73,482 and 62,357 respectively. It would appear from these numbers that the interest and enthusiasm of the students flag as the session advances, or else that the counter attractions of the winter prove too strong for a number of students.

THE October number of the Journal of the Association of Teachers in Technical Institutions contains the report of the council of the association for the year 1908–9. From this report we note that the association has applied to the Royal Commission on University and Higher Education in London to be allowed to lay its views on the subject before the commission, in the belief that the work of the commission will deal to a considerable extent with the polytechnics and technical schools of London. We also gather from an editorial note that the association, while anxious to secure coordination of the work of the polytechnics, looks on the scheme which has been put forward by the Education Committee of the London County Council as a curtailment of the powers of these institutions to do work of a university character, and is therefore opposed to the scheme. The association has also drawn up a scale of salaries for teachers in technical institutions in order to counteract the present tendency towards lower salaries. They propose that salaries of assistants begin at 150*l.* and go to 250*l.*, or 350*l.* for chief assistants in London polytechnics, and that heads of departments in the larger institutions have salaries from 350*l.* to 500*l.* per annum.

AT the meeting on November 24 of the Education Committee of the London County Council an important application from the Imperial College of Science and Technology was considered. The governing body desires the Council to make a grant of 8000*l.* to the college in respect of the financial year ending August 31, 1910, as compared with a grant of 5000*l.* for the previous financial year. Application was also made for a special grant of 350*l.* in respect of the teaching of aëronautics. The committee decided that, without in any way committing the Council to the payment of an annual grant, and subject to twenty-five free places being reserved for the Council's scholars, 8000*l.* should be allowed to the governing body of the Imperial College for the year named, that 5000*l.* of the amount should be paid during the current financial year, and the remaining 3000*l.* between April 1 and July 31 next. It was further agreed that the Council, in considering any future application for grant, should ask to be informed what steps had been taken by the governing body "to prevent overlapping and secure coordination of the work already carried on by university colleges, polytechnics, and other science and technological institutions, and the proper connection of the whole with the university," and also what further provision for maintenance is to be obtained from funds of a national character. The special grant for the teaching of aëronautics will not be made.

WE have received a copy of the annual report on the 113th session's work of the Glasgow and West of Scotland Technical College, adopted by the governors of the college at their meeting last September. The record of the year shows continued development in the work of the college; full advantage has been taken of the new departures enumerated in the report of last year, and these have had a satisfactory influence upon the standard as well as upon the volume of the work of the session. An important modification has been made in the general curriculum for the diploma awarded by the college, having especial reference to the examination tests to which candidates have been subjected hitherto. It has been the practice in the college to hold special sessional examinations in which it was necessary that a candidate for the diploma should show the attainment of a certain standard of proficiency. Although the examiners were in the habit of taking some note of the class-work before coming to a decision on the merits of a candidate, it was inevitable that the greatest weight should be attached to the results of these special examinations. The departure referred to consists in a reorganisation of the work for the diploma which will permit of the special being combined with the class examinations, and of a student's position each session being determined by the examiners after a review of his whole work for that, and, if need be, for the previous sessions. This review will take account of examinations, drawings, practical work as shown by laboratory books, and other classwork. Part of the work for the final year will be the preparation of a design, the composition of a thesis, or the like, done, not under examination conditions, but as nearly as possible under those which obtain in everyday professional life. It is interesting in this connection to note that Prof. Perry, F.R.S., who was appointed by the Scotch Education Department to make the special inspection of the college for this session, does not think it possible "for the college to take its proper position until it can confer the B.Sc. degree upon all its students who pass satisfactorily through courses of study which satisfy its own council of professors." His report has been brought before the notice of the Court of the University of Glasgow, and of a committee appointed by them to consider the question of future relations with the Glasgow and West of Scotland College.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 12.—Dr. C. Chree, F.R.S., president, in the chair.—P. V. **Bevan**: The absorption spectrum of potassium vapour. The method of studying the absorption spectrum was that used first by Roscoe and Schuster, and of late years elaborated by Prof. R. W. Wood. That the optically dense vapour has small density makes it possible to heat the metal in a tube, and to have enough vapour to show strong absorption of light with little distillation to the colder parts of the tube. A tube with quartz plate ends can be used, and the absorption spectrum studied with a quartz spectrograph. The most evident feature of the spectrum obtained is the appearance of the lines of the principal series. None of the lines of the two associated series appear, but additional channelled space spectra unrepresented in the emission spectra. Fifteen new lines have been obtained in the principal series by this method. In the invisible region there appears a channelled space spectrum in the red. This shows definite edges of bands towards the violet end of the spectrum. The wave-lengths of the edges of these bands were measured. When the ratios of these wave-lengths to that of the first member of the principal series are found, the values are found to be in the same range as the corresponding ratios as deduced from Wood's measurements on sodium absorption. This the author regards as evidence of connection between the channelled space spectrum and the principal series of lines. The remarkable feature of this absorption spectrum is the difference in the properties of the principal series lines from those of other lines in the emission spectrum. Some other lines are in emission spectra far stronger than the higher members of the principal series, yet do not appear at all in the absorption spectrum. This fact may indicate that the metallic vapour at the low temperature of these experiments is in a different molecular state from its state in a spark or flame, or that in these latter cases chemical action is going on and the emission spectrum is not a simple elementary spectrum.—J. S. **Dow**: Some further notes on the physiological principles underlying the flicker photometer. The author suggests that something may be learned regarding the physiological phenomena governing the flicker photometer by observing whether it is subject to certain physiological effects, such as the "yellow spot" and "Purkinje" phenomena. Experiments show that the effects referred to do occur, but are apparently much less marked. The author suggests an explanation based on the assumption that the rod-elements on the retina, in addition to the peculiarities attributed to these organs as regards the perception of light and colour, also differ from the "cones" in the fact that they seem to receive a luminous impression more slowly, and retain it longer than these organs. This peculiarity is of little consequence in an ordinary photometer of the equality of brightness type, but may play a part in the flicker instrument; it seems to explain why certain effects should be perceived more clearly in one case than in the other. According to this theory, we may imagine the flicker effect to be due to two distinct portions, received by the agency of the rods and cones respectively. Under certain conditions the speed of a flicker photometer may be supposed to be suitable for the use of "cone-flicker" but too high for the "rod-flicker," which becomes fused into a steady luminous impression, and thus does not affect the readings of the instrument. The author regards his experiments as being essentially of a suggestive character, requiring more detailed examination. One must be cautious in seeking to draw deductions from cases of colour-blindness, as many different varieties of this affliction exist.—Dr. Edridge **Green**: Colour-perception spectrometer. This consists of an ordinary spectrometer with a single prism, fitted with two wave-length drums, which work two shutters placed in the focal plane of the eyepiece. By means of the shutters any part of the spectrum can be viewed at will, and the wave-lengths of the edges of the patch under observation can be read off from the drums. Dr. Green described how the instrument is used for testing colour-blindness, and referred to the superiority of the method over those usually adopted.—H. G. **Savidge**: Tables of the ber and bei and ker and kei functions, with further formulæ for their computation.

Mineralogical Society, November 16.—Prof. W. J. Lewis, F.R.S., president, in the chair.—J. B. **Scrivenor**: An occurrence of native copper with tin ore in the Federated Malay States. In concentrates obtained in the final washing of the tin ore from the Rotan Dahan mine in the district of Kinta, Perak, the cassiterite was found to be mixed with a reddish mineral, which could not be separated from it. This proved to be native copper in minute and beautifully sharp crystals. The tin ore is obtained from a mass of partially decomposed soft schists overlying limestone, and the copper was probably the result of reduction *in situ* of a copper salt held in solution by water percolating through the schists.—Dr. G. T. **Prior**: A meteoric stone from Simondium, Cape Colony. Two or three masses of a meteoric stone were discovered in 1907, 100 yards apart and a foot below the surface, in gravel near Simondium Station, on the Paarl to French Hoek line, in Cape Colony. The masses, of which the largest was not more than a foot in diameter, were broken up by the finders, who supposed the particles of nickel-iron seen on the fractured surfaces to be native silver. Six of these fragments, which were preserved, have been presented to the British Museum collection by Mr. R. T. Hancock and Mr. R. H. Stanley, one of the prospectors who discovered the masses. The meteorite belongs to the less common class of aërolites which show no chondritic structure; it consists of enstatite, olivine, and felspar, with nickel-iron, magnetite, and some troilite.—L. J. **Spencer**: The occurrence of alstonite and ullmannite (a species new to Britain) in a barytes-witherite vein in the New Brancepeth Colliery, near Durham. A large vein of barytes, coinciding with a fault, in the New Brancepeth Colliery is worked commercially on a large scale for barytes, and has yielded many finely crystallised mineral specimens. These include barytes and witherite in large crystals, and the rare species alstonite and ullmannite (NiSbS, with 28 per cent. of nickel), the latter of which has not been previously recorded in the British Isles. Galena, blende, copper-pyrites, iron-pyrites, and melanterite are also present in small amount. The order of formation of the non-metallic minerals is (1) barytes, (2) witherite, and (3) alstonite, the two last having been derived from the barytes. The ullmannite is found as cubes of considerable size and as octahedra, and it sometimes forms a parallel intergrowth with galena.—Prof. W. J. **Lewis**: Sartorite and other minerals from the Binnenthal. A crystal of sartorite showing twin lamellæ was described.

Royal Anthropological Institute, November 16.—Prof. W. Ridgeway, president, in the chair.—F. G. **Parsons**: The Rothwell crania. The church of Rothwell is situated in the north of Northamptonshire. About 200 years ago some workmen discovered the existence of a crypt, in which was stored a large number of human skulls and other remains. The date *circa* 1700 is the latest, therefore, to which the skulls can be assigned. As, however, at the time of their discovery all knowledge of their existence had been lost, it is safe to consider 1600 as the latest possible date for them. On the other hand, they can hardly be earlier than 1180, which is the earliest date to which can be assigned the vault in which they are stored. There are probably some five or six thousand individuals represented in the vault, and it is practically certain that, as at Hythe, the bones represent the burials of a very considerable number of years, removed at various times to the vault when the graveyard became overcrowded. It seems justifiable, therefore, to consider the bones as being the remains of English men, women, and children, most of whom lived in the fourteenth and fifteenth centuries. It is interesting to notice that, except for a greater breadth of forehead, these Rothwell crania are almost identical with those of the students at St. Thomas's Hospital, measured by the author. On the whole, however, the Rothwell crania are slightly larger. The bones are in a very bad condition owing to the damp.

Royal Meteorological Society, November 17.—Mr. H. Mellish, president, in the chair.—C. J. P. **Cave**: Methods employed for observing pilot balloons used for investigating the currents of the upper atmosphere. Two theodolites are used, each at the end of a measured base-line, and observations of the balloon are taken each minute from its start. The readings are subsequently worked out and plotted graphically, when the height, direction, and rate of travel of the balloon during its course are determined. The best time for observing balloons is shortly before sunset, as the sky will be becoming dark when the balloon reaches its greatest height, and, being illuminated by direct sunlight, will shine like a star. The author has seen a balloon burst at a distance of forty miles under these conditions. The rate of ascent of balloons is found to vary considerably near the ground, and in cloudy weather, particularly when there is cumulus cloud, but higher up the rate of ascent remains fairly uniform up to great heights.—W. **Marriott**: Registering balloon ascents at Gloucester, June 23 and 24, 1909. During the Royal Agricultural Society's recent show the author sent up *ballons-sondes* with recording instruments on three consecutive days. Two of the meteorographs were found and returned. The balloon on June 23 fell thirty-seven miles south-east, and that on June 24 fell forty-three miles north of Gloucester. The records showed that the temperature decreased pretty uniformly up to between five and six miles; above that height the temperature increased somewhat, and then kept nearly stationary up to the highest point reached by the balloons, about twelve miles. The temperature recorded on June 23 was higher than that recorded on June 24, and the point of change, or the so-called "isothermal layer," was about half a mile lower in altitude. This was probably due to the balloon on June 23 having ascended on the eastern side of the centre of a cyclone, while that on June 24 ascended on the western side of the centre.—W. P. **Brown**: Winter temperatures on mountain heights. In 1867 the author placed a minimum thermometer on the summit of Y Glyder-fach, a mountain near Snowdon, and 3262 feet above sea-level, and this has been regularly observed and the lowest winter readings recorded each year. The author gives the readings in full.—E. **Gold**: The semi-diurnal variation of rainfall. The results of the author's investigation seem to indicate that the upward motion associated with the semi-diurnal variation of pressure is the probable cause of the semi-diurnal variation of rainfall.

Geological Society, November 17.—Prof. W. J. Sollas, F.R.S., president, in the chair.—A. R. **Andrew** and T. E. G. **Bailey**: The geology of Nyasaland. E. A. N. **Arber**: Description of the fossil flora. R. B. **Newton**: Notes on the non-marine fossil Mollusca. Dr. R. H. **Traquair,** F.R.S.: Description of the fish-scales of Colobodus, &c. The greater part of Nyasaland consists of crystalline rocks, which comprise:—(*a*) metamorphosed sedimentary beds, including graphitic gneisses with limestones, and muscovite-schists; (*b*) foliated igneous rocks, especially augen-gneiss; (*c*) plutonic intrusions, usually granite or syenite, more rarely gabbro. In the N.W. corner of Nyasaland is an altered sedimentary series, which forms the Mafingi Hills. It consists of accumulations of quartzites, grits, and sandstones of pre-Karoo age. The Karoo system is represented both in the north and in the south of Nyasaland; in the north it occurs in patches. It has afforded remains of fresh-water lamellibranchs (Palæomutela), fish-scales (Colobodus), and species of Glossopteris. Recent lacustrine marls and sands are found at great heights above the present level of the lake, and as much as fifteen miles away from its margin. Pumiceous tuffs are found in the north of the country; across the border, in German East Africa, Tertiary and recent lavas and tuffs are distributed widely. Nyasaland consists of high plateaux rising irregularly one above the other.—S. **Smith**: The faunal succession of the Upper Bernician. The Bernician series forms the upper division of the Lower Carboniferous sequence of Northumberland. Below the Bernician lie the Tuedian beds. The Northumberland succession, together with the Lower Carboniferous rocks north of the Tweed, occupies the northern extremity of the Pennine province of the Carboniferous Limestone series. The Carboniferous strata in Northumberland encircle the Cheviots on the south, east, and north, and dip from the volcanic inlier. The Bernician is mainly built up of sandstones and shales, but intercalated are beds of limestone and numerous seams of coal. In the Upper Bernician the limestones are fairly thick, constant, and truly marine. The calcareous beds of Lower Bernician age are thin, impure, and frequently contain Stigmaria. There are a few good marine limestones of local occurrence. The Upper Bernician answers to Tate's calcareous group, while the Lower Bernician is equivalent to Tate's carbonaceous group. It is with the Upper Bernician only that the present paper is concerned. The whole of the Upper Bernician Limestones belong to the Dibunophyllum zone, but they are capable of palæontological subdivision, as is given in the paper.—M. K. **Heslop** and Dr. J. A. **Smythe**: Notes on the dyke at Crookdene (Northumberland), and its relations to the Collywell, Morpeth, and Tynemouth dykes. The dyke at Crookdene is exposed in the bed and banks of the Wansbeck above Morpeth. It is intruded along a fault-fissure in beds of Bernician age. The basalt contains narrow lath-shaped felspars and curved augites. Large inclusions of a felspar, closely allied to anorthite, occur. The exterior of the inclusions in contact with the ground-mass is zoned; the individual crystals are intergrown, cracked, faulted, and in places shattered. These phenomena point to a plutonic origin of the felspathic inclusions, and connect them with the porphyritic felspars of the Tynemouth Dyke, for which a similar origin has been suggested by Dr. Teall. The dyke, which comes to a head in the coast-section at Collywell, shows the same peculiarities. The two basalts are practically identical. It appears probable that they belong to the same intrusion. The work of Dr. Teall has been amplified by further observations. The resemblances among the four dykes are so strong as to render it probable that they are derived from a common source.

Royal Microscopical Society, November 17.—Mr. F. J. Cheshire, vice-president, in the chair.—E. **Heron-Allen** and A. **Earland**: The recent and fossil Foraminifera of the shore-sands of Selsey Bill, Sussex, part iv. This paper covered the genera Cycloloculina to Nummulites inclusive, and included many rare and interesting forms, but no new species. Of the genus Cycloloculina, first described by the authors in 1908 from this locality, a few additional details were mentioned, but the original source of the specimens still remains doubtful, although its distribution has now been worked out over an extensive area of the peninsula. The evidence, however, points to the Eocene beds of Bracklesham Bay as the source from which the specimens were derived, although none have been found *in situ*. The paper was illustrated by a series of lantern-slides, photographed from specimens specially mounted for the purpose.

Linnean Society, November 18.—Dr. D. H. Scott, F.R.S., in the chair.—W. **Wesché**: A new Tipulid subfamily. The flies which form this well-marked subfamily were brought to the author's notice by Lieut.-Colonel Winne Sampson, who collected them in S. Nigeria. The striking proboscis, more like the mouth-parts of the Culicidæ than of the Tipulidæ, marks them off from all other genera of the latter family, except Geranomyia; but though Geranomyia has greatly developed mouth-parts, they are quite different in type, the paraglossæ being cleft, and the palpi, though single-jointed, being situated at the base of the labium instead of at the tip, as is the case in the Ceratochilinæ. Colonel Winne Sampson's specimens were all mounted as preparations for the microscope, but the author found five pinned, unnamed insects in the British Museum which had been collected by Dr. Graham in Ashanti, and which agreed with the Nigerian species as regards the trophi and peculiar antennæ, but presented generic differences in the wing venation. This genus he has called Neoceratochilus, as the venation is less archaic in type than that of the other genus, which the author names Ceratochilus, or horned or palped lip.—J. M. **Brown**: Fresh-water rhizopods from the Lake District. The author stated that between forty and fifty species had been obtained from Sphagnum and sediment from tarns and lakes, amongst them some which had not been previously recorded as occurring in Britain, with one species new to science. After enumerating the forms found at certain localities, the author gives some critical remarks on some of the species obtained.

Zoological Society, November 23.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—G. C. **Shortridge**: An account of the geographical distribution of the Marsupials and Monotremes of South-west Australia, having special reference to the specimens collected during the Balston Expedition of 1904–7.—Mrs. E. W. **Sexton**: Notes on some Amphipoda from the north side of the Bay of Biscay. The paper contained notes on the development of the females of certain Amphipoda, showing that structural modification continues even after sexual maturity is reached, and this may give rise to differences of so striking a character that earlier and later stages might easily be mistaken for distinct species. This was illustrated by examples from the families Pleustidæ and Eusiridæ.—Lieut.-Colonel J. M. **Fawcett**: Aberrations in Nymphalinæ from the Andaman Islands, and of *Papilio clytia* from Burma.—R. **Lydekker**: Note on the cetacean *Sotalia borneënsis*. A correction of the author's description of this species published in the society's Proceedings for 1901 (p. 88, pl. viii.).

DUBLIN.

Royal Dublin Society, November 23.—Prof. H. H. Dixon, F.R.S., in the chair.—J. **Adams** and Prof. T. **Johnson**: Bacterial rot in the turnip and other brassicas. Three different bacterial diseases are referred to:—(1) brown rot of turnips caused by *Pseudomonas campestris*, Smith; (2) white rot of turnips caused by *Pseudomonas destructans*, Potter; (3) black rot of cabbages caused by *Bacillus oleraceae*, Harrison. The characters of each are described, and an outline of their distribution in Ireland is given. A comparison of the characters of the organisms responsible for numbers (2) and (3) is given in parallel columns, and the inference is drawn that they are the same species. Further confirmation of this conclusion is afforded by infection experiments.—Prof. Henry H. **Dixon** and W. R. G. **Atkins**: Osmotic pressure in plants and on a thermo-electric method of determining freezing points. In this paper the authors describe a thermo-electric method of cryoscopy, and arrangements by which the freezing point of small quantities of liquids (about 2·5 c.c.) may be determined with considerable accuracy to 0·01° C. The method was devised for determining the freezing points of the cell-sap of plants, and by that means to obtain the value of the osmotic pressure in the tissues. More than a hundred determinations were made, and these showed pressures in the leaves of plants ranging from 3·7 to 27 atmospheres. So far as the observations have gone, assimilation appears to be the most important external factor controlling the osmotic pressure of the leaves, which may vary widely in the same plant. Exposure to conditions favouring the fixation of carbon may cause the upper leaves to have a higher osmotic pressure than the lower, or *vice versa*. The determinations of the osmotic pressure are in most cases accompanied with determinations of the mean molecular weight of the substances giving rise to the pressure, so that some idea of the nature of these substances may be formed. The roots examined showed a lower osmotic pressure than the leaves.—Dr. J. R. **Sutton**: Some observations of dew at Kimberley (South Africa). This paper gives the results of some routine observations of dew. The author concludes that, contrary to the usual statements of the text-books, a clear sky is by no means essential to the formation of dew. A clear sky will, as a rule, hasten the beginning of the condensation of moisture from the air, but in the long run as much dew may be deposited when there are clouds as when there are none. When the air is very near the saturation point, the radiation of heat from the earth's surface is not much more intense under a clear sky than it is under clouds. Dew-making is not so much a function of the clearness of the sky as of the dampness of the air and the length of the night.

Edinburgh.

Royal Society, November 22.—Sir William Turner, K.C.B., president, in the chair.—Prof. Alex. **Smith** and Prof. A. W. C. **Menzies**: A new hydrate of orthophosphoric acid. The new hydrate has the composition $10H_3PO_4,H_2O$. It was obtained in quantity by concentrating orthophosphoric acid to 96 per cent., and keeping it at 24·38°. Mechanical stirring for a few hours brought about crystallisation, the crystals being large transparent prisms similar to those of Joly's hydrate.—Dr. J. A. **Gunn**: The pharmacological action of harmaline. Harmaline is one of two alkaloids found in the seeds of *Peganum harmala*. These seeds have been used medicinally, especially in India, for a variety of purposes, but the nature of their pharmacological action has not been thoroughly investigated. The present investigation shows that harmaline belongs to the group of general protoplasmic poisons, and resembles quinine in its pharmacological actions.—Dr. D. Berry **Hart**: Mendelism and zygotic segregation in the production of anomalous sex, i., the Free-Martin. John Hunter first described the anomalous sterile twin, known as the Free-Martin, found chiefly in black cattle. The Free-Martin is a sterile animal like a heifer, the co-twin of which is a potent bull. John Hunter described three specimens, and, on naked-eye examination, stated that the sexual gland was an ovary in one, a testis in a second, and that in the third both ovary and testis were present. Spiegelberg, of Breslau, examined a Free-Martin calf the co-twin of which was a bull, and described the organs in detail, concluding that the Free-Martin was a sterile bull with very rudimentary Müllerian relics. Numan, of Utrecht, published a memoir on sterile cattle, and figured several specimens comparable with John Hunter's. Although in error in some of his conclusions, he established a most important fact, which Dr. Berry Hart had anticipated theoretically, viz. that there may be a Free-Martin with rudimentary external male genitals the co-twin of which is a potent female. This Free-Martin (Stier-Kween of the Dutch) is thus a sterile female. The conclusion arrived at in the paper was that the Free-Martin and its twin were derived from a single zygote, the potent organs being segregated in the potent twin, the non-potent in the sterile animal. Thus a male zygote gave rise to a potent bull and a sterile bull, the ordinary Free-Martin, while a female zygote gave a potent female and a sterile female. The potent and non-potent elements in each sex behave usually as a complete unit, but in black cattle they segregate in twinning. This explains the puzzling anomaly. The potent and sterile twins may thus be described as an extracted dominant and an extracted recessive respectively, and placed in F^2 of the ordinary Mendelian scheme.—Dr. Thomas **Muir**, F.R.S.: The theory of orthogonants in the historical order of development up to 1860.

Paris.

Academy of Sciences, November 22.—M. Bouchard in the chair.—G. **Darboux**: Congruences of curves.—Yves **Delage**: The true causes of the supposed electrical parthenogenesis. A repetition, under more stringent conditions, of the experiments described in an earlier paper has shown that the conclusions given were not well founded. Electric charges, as such, do not produce parthenogenesis. Electrolysis produces a slight effect, solely on account of the formation of acid and alkali at the electrodes.—A. **Lacroix**: The existence of rhodizite in Madagascar pegmatites. This mineral is a boroaluminate of beryllium, lithium, sodium, and potassium, of the composition

$$6B_2O_3.4Al_2O_3.4BeO,4(Li,K,Na,H)_2O.$$

—Lecoq **de Boisbaudran**: The band spectra of barium and aluminium.—M. Simon was elected correspondant for the section of anatomy and zoology, in the place of the late M. Bergh.—M. **Borrelly**: Observations of Halley's comet made at the Observatory of Marseilles with the comet finder. The positions of the comet and comparison stars are given for November 19 and 20.—J. **Haag**: Certain groups of families of Lamé.—S. **Carrus**: The integration of partial differential equations.—Marcel **Riesz**: Dirichlet's series and integral series.—B. **Szilard**: An apparatus for radio-active measurements. An instrument based on the principle of the electroscope, but in which the gold leaf is replaced by a rigid index, a magnetised steel needle.—Georges **Claude**: The desiccation of air before liquefaction. A small quantity of alcohol, nearly equal to the weight of water vapour in the air, is added to the air on its way to the compressor; this does not solidify, and can be readily separated in liquid form in the course of the cooling process.—A. **Dufour**: Asymmetry of certain emission bands of vapours in the Zeeman phenomenon.—E. **Caudrelier**: The function of the capacity of the electrodes in the discharge of inductors.—MM. **de Broglie** and **Brizard**: Chemical reactions and ionisation of gases. A criticism of work of M. Reboul on the same subject.—Jean **Meunier**: The conditions necessary for platinum to remain in a state of incandescence in a Bunsen burner. Experiments are detailed tending to show that the property of remaining incandescent in an air-gas mixture is not due to the platinum alone, but to minute traces of saline substances of the order of 0·001 milligram carried by the wire.—H. **Dautriche**: The working of safety explosives containing ammonium nitrate in presence of coal, paper, and paraffin. Coal-dust surrounding the cartridge is burnt to carbon monoxide during the explosion.—A. **Guyot** and A. **Gry**: Some new syntheses of vanillin. Mesoxalic ether and an αβ-diketonic ester are condensed by chloride of zinc in glacial acetic acid, and the product converted into a vanilloyl-carboxylic acid by heating with an aqueous solution of copper acetate.—Marcel **Guerbet**: Some condensation products of camphor.—Henri **Lecomte**: Floral pedicels.—M. **Marage**: Studies of laryngeal vibrations.—J. **Comandon**: The kinematography of living micro-organisms and mobile particles with the aid of the ultra-microscope.—M. **Baudran**: A tuberculous endotoxine of albumose nature. The separation of the albumose from the bacilli is described in detail; it proved to exert toxic effects on guinea-pigs.—L. **Bull**: Researches on the flight of insects.—C. **Gerber**: The ferment of the Basidiomycetes.—A. **Goris** and M. **Mascré**: The existence in *Primula officinalis* of two new glucosides hydrolysable by a ferment. The glucosides are named primeverine and primulaverine; both are unacted upon by emulsin, but are hydrolysed by boiling dilute sulphuric acid.—E. L. **Trouessart**: A new insectivorous type (*Neotetracus sinensis*) from western China.—Jean **Boussac**: The Nummulitic of the eastern Alps.

New South Wales.

Royal Society, August 4.—Mr. H. Deane, vice-president, in the chair.—J. H. **Maiden** and R. H. **Cambage**: Botanical, topographical, and geological notes on some routes of Allan Cunningham.

September 1.—Dr. Walter Spencer, vice-president, in the chair.—T. H. **Johnston**: A new genus of bird-cestodes.—S. G. **Walton**: A complete analysis of Sydney water.—J. H. **Maiden**: A plea for the study of phenological phenomena in Australia.

Cape Town.

Royal Society of South Africa, October 20—Mr. S. S. Hough, F.R.S., president, in the chair.—Dr. M. **Wilson**: Nutmeg poisoning. The symptoms were described and attention directed to the small number of cases recorded. As the condiment was used practically throughout the whole world, the explanation must be that a few nutmegs had gone into circulation after germination had begun and then been arrested. In support of this the author directed attention to the fir seed (dana pitje), which was greatly relished and largely eaten by children near Cape Town without any bad results; but when one seed which had started to germinate was eaten, the results were very serious and dangerous.—Dr. R. **Broom**: Observations on some specimens of South African fossil reptiles preserved in the British Museum. The following are some of the conclusions come to by the author:—All the later specimens which have been referred to Galesaurus are held to belong to a different genus and species, and must take Owen's name *Nythosaurus larvatus*. Gorgonops is held to be closely allied to Titanosuchus, and to be really a dinocephalian. Theriognathus is believed to be very distinct from Endothiodon, and to be really a therocephalian. Anthodon is held to include at present two entirely distinct forms. The type is a small pareiasaurian from the Permian beds of Styl-Krantz. The teeth from the

Cretaceous bed of the Bushman's River, which have hitherto been placed under Anthodon, are held to be dinosaurian, and for them the new name *Palacoscincus africanus* is proposed.—L. **Péringuey** and E. J. **Phillips**: Notes on a zoological and botanical collections from the group of islands of Tristan d'Acunha, made by Mr. J. C. Keytel, 1908–1909. The botanical specimens came from Tristan only, while a few birds were obtained from Nightingale Island; the remainder, however, was collected at Tristan itself. Mr. Keytel collected seven of the twenty species endemic to the island, as well as sixteen plants that have been introduced within the last thirty years, as no mention is made of them by Moseley, of the *Challenger* expedition; among the birds was found a cuckoo, a native of South America, *Coccyzus melanocoryphus*. Among the insects, all but one are introductions, mainly from the Cape, but also from extreme South America. The Cape crawfish, *Jasus lalandei*, occurs also at Tristan, as well as several fishes found on the Cape Colony coast.—A. W. **Roberts**: Absorption of light by the atmosphere. The investigation was undertaken for the purpose of obtaining a value of the coefficient of absorption for South Africa. Taking the means of all the results, Dr. Roberts obtains as the value of the coefficient of atmospheric absorption $0^{m}20$, which, interpreted into other terms, means that 17 per cent. of all rays that strike the atmosphere perpendicularly are absorbed by the atmosphere.—L. **Péringuey**: The age of Stone (Palæolithic) in the Drakenstein Valley and the manner in which the implements were made. A large collection of implements of a huge size were exhibited. It was found possible from the material found in that valley to reconstruct the artificial working of those implements from the fractured, water-worn quartzite boulder to implements of a finish equal to the best Acheulean. The division of Chellean, Acheulean, Mousterian, cannot be adopted in South Africa, as the three typical forms were found together and in all stages of finish. The extreme antiquity of the implements shown was demonstrated by the well-nigh disintegrating sandstone of which they are made, as well as by the abraded edges of many of these palæoliths. In fact, some that had been long exposed seem to be preserved by the patina they acquired through the exposure.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 2.

RÖNTGEN SOCIETY, at 8.15.—Some Effects of Electrical Discharges on Photographic Plates: Prof. A. W. Porter.

LINNEAN SOCIETY, at 8.—Nudibranchs from the Indian Ocean: Sir Chas. Eliot, K.C.M.G.—Trichoptera von Mr. Hugh Scott, auf den Seychellen gesammelt: Dr. Georg Ulmer.—Report on the Brachiopoda obtained from the Indian Ocean by the *Sealark* Expedition, 1905: Dr. W. H. Dall.—Narrative of the *Sealark* Expedition, Part III.: Prof. J. Stanley Gardiner, F.R.S., and others.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Testing of Tanning Materials from a Dyer's Standpoint: W. P. Dreaper.—Methods of Testing Dyes for Fastness: Dr. E. Feilmann.—Some Problems in Leather Dyeing: M. C. Lamb.—The Purchase and Testing of Dyestuffs: H. P. Pearson.

FRIDAY, DECEMBER 3.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design of Generating Stations: G. Ingram.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Resumed discussion*: An Internal-combustion Pump, and other Applications of a New Principle: H. A. Humphrey.

GEOLOGISTS' ASSOCIATION, at 8.—The Volcanic and Alpine Regions of New Zealand: A. E. Kitson.

SATURDAY, DECEMBER 4.

ESSEX FIELD CLUB, at 6 (at Essex Museum of Natural History, Stratford).—Surface Tension and its Relation to Life at the Surface of Water: S. G. Starling and D. J. Scourfield.

MONDAY, DECEMBER 6.

ARISTOTELIAN SOCIETY, at 8.—The Subject-matter of Psychology: G. E. Moore and G. Dawes Hicks.

ROYAL SOCIETY OF ARTS, at 8.—Aëronautics: C. C. Turner.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Artificial Silk Industry: W. P. Dreaper.

VICTORIA INSTITUTE, at 4.30.—The Ivory Islands of the Arctic Ocean: Rev. D. Gath Whitley.

TUESDAY, DECEMBER 7.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Marine Propulsion by Electric Motors H. A. Mavor.

WEDNESDAY, DECEMBER 8.

ROYAL SOCIETY OF ARTS, at 8.—The Destruction of Plumage Birds: J. Buckland.

THURSDAY, DECEMBER 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Hexosephosphate formed by Yeast-juice from Hexose and Phosphate: W. J. Young.—On the Presence of Hæmagglutinins, Hæm-opsonins, and Hæmolysins in the Blood obtained from Infectious and Non-infectious Diseases in Man (Third Report): L. S. Dudgeon and H. A. F. Wilson.—Gametogenesis of the Gall-fly *Neuroterus lenticularis* (*Spathegaster baccarum*): L. Doncaster.—Preliminary Note upon the Cell Lamination of the Cerebral Cortex of Echidna, with an Examination of the Fibres in the Cranial Nerves: Dr. E. Schuster.—Cortical Lamination and Localisation in the Brain of the Marmoset: Dr. F. W. Mott, F.R.S., Dr. E. Schuster, and Prof. W. D. Halliburton, F.R.S.—The Caudal Fin of Fishes (Preliminary Paper): R. H. Whitehouse.—Some Experiments with the Venom of *Causus rhombeatus*: H. E. Arbuckle.—On the Comparative Action of Stovaine and Cocaine as measured by their Direct Effects upon the Contractivity of Isolated Muscle: Dr. V. H. Veley, F.R.S., and Dr. A. D. Waller, F.R.S.—A Critical Study of Spectral Series. Part I., The Alkalies, H and He: Prof. W. M. Hicks, F.R.S.—On the Distribution of the Röntgen Rays from a Focus Bulb: G. W. C. Kaye.—On the Nature of the Ionisation of a Molecule by an α Particle: R. D. Kleeman.—Conduction of Heat through Rarefied Gases: F. Soddy and A. J. Berry.—Harmonic Tidal Constants for Certain Chinese and New Zealand Ports: T. Wright.

MATHEMATICAL SOCIETY, at 5.30.—Exhibition of an Instrument for Solving Cubic Equations: T. H. Blakesley.—The Connection between the Theories of the Singularities of Surfaces and Double Refraction: A. B. Basset.—On the Representation of a Group of Finite Order as a Group of Linear Substitutions with Rational Coefficients: Prof. W. Burnside.—The Eliminant of the Equations of Four Quadric Surfaces: A. L. Dixon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes on Methods and Practice in the German Electrical Industry: L. J. Lepine and A. R. Stelling.

ROYAL SOCIETY OF ARTS, at 4.30.—The Punjab: Sir James Wilson, K.C.S.I.

FRIDAY, DECEMBER 10.

PHYSICAL SOCIETY, at 8.—Annual Exhibition.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—Note on the very young Stage of the Genus Humphreyia: G. A. Smith.—A Further Note on the Anatomical Differences between the Genera Cypræa and Trivia: H. O. N. Shaw.—A New Mexican Genus of Pleuroceratidæ: Prof. H. A. Pilsbry.—Notes on a Collection of Terrestrial Land Shells from Angola, with Description of New Species: H. B. Preston.—Notes on the Genus Libera: J. H. Ponsonby.

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THURSDAY, DECEMBER 9, 1909.

PLANT RECORDS OF THE ROCKS.

Studies in Fossil Botany. By Dr. Dukinfield H. Scott, F.R.S. Second edition. Vol. I., Pteridophyta. Pp. xx+363. Price 6*s.* net. Vol. II., Spermophyta. Pp. xiii+(355–676). Price 5*s.* net. (London: A. and C. Black, vol. i., 1908; vol. ii., 1909.) Price, 2 vols., 10*s.* 6*d.* net.

IN the preface to the first edition the author expressed the hope that the palæontological record "will no longer be ignored by students of the evolution of plants." Since these words were written the study of the plant-records of the rocks has made steady progress, not only as regards results, but in the vigorous growth of interest shown in the relics of past floras. This remarkable activity is in large measure the direct result of the influence exerted by Dr. Scott, not only by his own researches and by the encouragement and generous assistance which he is always ready to give to younger workers, but in no small degree by his well-balanced and lucid treatment of that branch of botany to which he has devoted himself with conspicuous success.

The recent issue of the "Studies" is a new edition in more than name; two volumes replace the single volume in which the lectures were originally published, and, as the result of the rapid progress of palæobotanical work during the last eight years, many of the chapters have been largely re-written and others have been amplified. In the section devoted to the Equisetales the additions are few; reference is made to Mr. Hickling's recent account of the course of the vascular bundles in the sporangiophores of *Palaeostachya vera,* and to Halle's monograph of Mesozoic species of Equisetites. In the first edition a brief reference was made to the important discovery of Lepidocarpon, a seed-bearing lycopodiaceous strobilus: subsequent work by Dr. Scott and others has now rendered possible a more adequate treatment of this and similar types. A drawing of a transverse section of *Lepidodendron Wunschianum,* published in the first edition, is again reproduced with a broad band of tissue labelled "phloem," though it consists of extremely short parenchymatous cells, and a few immature xylem elements. It is a fact of considerable interest that in Lepidodendron stems which have formed a broad cylinder of secondary xylem, no true secondary phloem has been discovered. To the consideration of this question Dr. Scott hardly does justice. There are still many points to be cleared up in regard to the morphology of Palæozoic lycopods, and this can be done only by a detailed comparative treatment of all known species, founded on anatomical characters.

It is, however, especially in the account of the ferns that the results of recent investigations are most apparent. The student of Palæozoic ferns has now to face the difficulty of distinguishing between true members of the Filicineæ and fern-like plants which bore seeds. The account of the Botryopterideæ, a group of ferns which has gained considerably in importance since the removal of many genera of Palæozoic "ferns" to the new group Pteridospermeæ, is particularly welcome as coming from one who is exceptionally well qualified to deal with these still imperfectly known types. The excellent description, which is necessarily condensed, leads one to express the hope that Dr. Scott will soon publish a more comprehensive account of his researches into the structure and affinities of these generalised ferns. The account of the genus Lyginodendron has been modified as the result of Dr. Kidston's important contribution to our knowledge of the male reproductive organs, which had been previously referred to Zeiller's genus Crossotheca and regarded as fern sporangia. The chapter on the Medulloseæ contains interesting new matter, including some admirable drawings by Mr. Maslen of the seed Trigonocarpon and photomicrographs illustrating Prof. Oliver's recent work on the multicellular pollen-grains, and what are believed to be the remains of motile male gametes of Stephanospermum.

A word of praise is due to the publishers for the quality of the type and for the successful reproduction of the illustrations. Some new figures have been added, the most striking of which is, perhaps, a drawing of a transverse section of a young vascular bundle of *Botryopteris hirsuta,* showing the thin-walled immature xylem, with a few lignified protoxylem elements. It is no exaggeration to say that the volumes before us afford the most convincing demonstration so far presented in book-form of the possibilities of palæobotanical research. As we read the descriptions of many of the extinct types, and note the perfection of the preservation of their tissues, we forget that the material from which the data have been obtained has for countless ages been entombed in the older rocks of the earth's crust.

Though mainly concerned with Palæozoic plants, Dr. Scott adds a chapter on Mesozoic gymnosperms, in which special attention is directed to Mr. Wieland's able monograph of the remarkable silicified cycadean stems from America. In the clearly written account of these plants, emphasis is laid on the striking differences between their flowers and those of recent cycads, a difference which is necessarily somewhat obscured by the application of the term cycad to plants the reproductive organs of which differ *toto coelo* from those of the Cycadaceæ. The opinion held by several botanists that the results of Mr. Wieland's work afford a clue to the solution of the problem of the origin of the angiosperms receives due attention. Bearing in mind the scope of the "Studies," it would be unreasonable to find fault with the brevity of the section devoted to the past history of the Coniferales. In the admirable chapter devoted to general results, the author adopts a new grouping of the vascular plants, which he naturally speaks of as provisional. As knowledge increases, we conveniently record progress towards what we believe to be a closer approximation to a natural scheme of classification by means of changes in the arrangement of the subdivisions or by a redistribution of genera. Any change challenges criticism, but, whether accepted or not, it stimulates discussion and helps us to correlate our ideas. Bacon's aphorism, "Truth more easily comes out of error than out of confusion," may be applied to any honest attempt to express progress in knowledge by a re-adjustment of existing classifications. These words may seem to imply a disinclination to accept the views embodied in Dr. Scott's classification; they are quoted rather as an expression of gratitude for a contribution the value of which is to be measured, not by considerations of finality, but by the stimulus which it gives to wholesome criticism and to a broader survey of the facts at our disposal.

By the expansion of the "Studies," Dr. Scott has given a further incentive to students of plant evolution, and has produced a book which, in clearness of exposition, in scientific accuracy, and in soundness of judgment, it would be difficult to surpass.

A. C. Seward.

PISCINE MORPHOLOGY.

A Treatise on Zoology. Edited by Sir Ray Lankester, K.C.B., F.R.S. Part IX., Vertebrata Craniata. First Fascicle, Cyclostomes and Fishes. By E. S. Goodrich, F.R.S. Pp. xvi+518. (London: A. and C. Black, 1909.) Price 20s. net.

BOTH the author of this book and the editor of the "Treatise on Zoology" are to be congratulated on this, the latest addition to the series. The author is dealing with a subject with which he is thoroughly familiar, and to which he has contributed a large amount of important research. The whole plan of the book is carefully conceived and carried out, and we can only regret that the necessity to keep the size of the book within certain limits has made great concentration inevitable in dealing with many parts of the subject. However, references to more than five hundred original papers afford a guide to the student who wishes to amplify Mr. Goodrich's text.

This book is less a mere compilation than are most text-books, and the personality of the author is constantly felt. One of the chief features is the great number of excellent new figures, largely semi-diagrammatic representations of dissections, showing the three dimensions of space. Readers will be deeply grateful for this, for we have all experienced the annoyance of turning up text-book after text-book in the attempt to clear up some doubtful point, and finding the same figure, taken from some time-honoured authority, reproduced in all. How little the book before us suffers from this common failing is evident when it is said that more than a hundred and fifty of the figures are of the author's own drawing.

The subject is considered from a purely morphological and evolutionary point of view, to the almost complete exclusion of the physiological side, and the references to function are extremely few. While it is necessary in a book of limited length to discriminate between what to put in and what to leave out, one feels, perhaps, that in this case the fact that organs are functional parts of living animals has been kept too much in the background.

It is natural, and also desirable, that an author should treat at most length those parts of his subject to which he himself has given most attention, even at the expense of other portions. Here, many of the "soft-parts," for example, the nervous system, and the digestive organs receive rather scant attention. On the other hand, the supporting tissues, especially the exoskeleton and the skeleton of the median and paired fins, are admirably treated, and at considerable length.

The classification adopted differs in many respects from that found in contemporary text-books. The Pisces are divided into three great groups, the Chondricthyes, Ostracodermi, and Osteichthyes. The Chondricthyes include the Elasmobranchii (Selachii and Holocephali) and the extinct groups usually associated with them. The Osteichthyes are divided into two groups, the first including the Dipnoi and Coccosteomorphi, the second the Teleostomi. Useful phylogenetic trees are given at the beginning of the larger groups. In dealing with the Teleostei, use is freely made of subdivisions represented only by letters or numerals, thus saving the coining of new words—a most desirable proceeding in dealing with a provisional classification, such as that of the Teleosteans must at present be.

A few special points of minor importance call for criticism. On p. 11 we read that

> "Stöhr showed that, in the Urodela, the 'vertebral region' is developed from three distinct centres—the parachordal, the mesotic cartilage of the auditory capsule, and an occipital segment resembling a vertebra."

This is a very confusing use of the terms, neither in accordance with Stöhr's original usage nor with that commonly accepted at present. Stöhr divided the post-trabecular elements of the skull into three, the "Balkenplatte," mesotic cartilage, and occipital portion, and identified the *last* of these with Huxley's parachordals. The custom now is to use the word parachordal as including all these three sections. The student will have difficulty in reconciling Mr. Goodrich's use of the term with either of the other two meanings.

On p. 116 we read, as one of the *primitive* characters of the Pisces (which group here does not include the Cyclostomes), that the pericardium may communicate with the abdominal cœlome. In view of the fact that this communication in Elasmobranchs is formed secondarily in ontogeny after the two cavities have been completely separated from each other, it would have been better not to have included it in the list of characters "considered primitive" without a qualifying note.

"Occipital" (p. 239) hardly seems a happy name for the large dermal bone of the Dipnoi (Wiedersheim's fronto-parietal), which, indeed, roofs in the whole cranium in the Dipneumona.

Considering the book as a whole, we may say confidently that, in spite of the number of excellent text-books already available, Mr. Goodrich's work will be extremely welcome to the student of vertebrate morphology, as being both a trustworthy source of general information on the subject and in many points an epitome of recent research by one who has himself taken a most important part in it.

W. E. A.

FRENCH SYLVICULTURE.

Sylviculture. By Albert Fron. With an introduction by Dr. P. Regnard. Second edition. Pp. 496. (Paris: J. B. Baillière et Fils, 1909.)

MR. G. WERY, the sub-director of the Institut Agronomique, is the editor of the French "Agricultural Encyclopædia," which consists of sixty volumes, each containing 400—500 pages, copiously illustrated, and sold in paper covers at 5 francs each, or bound for 6 francs. The subjects dealt with are distributed under six headings, as follows:—

(1) *Cultivation and Improvement of the Soil.* General agriculture; manures.

(2) *Production of Plants.* Agricultural botany; cereals; fodder plants; garden vegetables, orchards, vines, diseases of cultivated plants. Fron's sylviculture comes under this heading.

(3) *Production of Animals.* Agricultural zoology; entomology and the study of animal parasites; farm stock; breeding and rearing horses; fish; bees; birds; game, &c.

(4) *Agricultural Technology.* Dairy farming; brewing; flour-mills; cider, wine; also agricultural chemistry in two volumes.

(5) *Rural Engineering.* Agricultural machines; motors; buildings; survey; drainage.

(6) *Rural Political Economy, and Law.* This comprises six volumes, including hygiene.

We have therefore a splendid series of cheap scientific books by professors and experts of agriculture and of the allied arts, and if the other subjects are treated as skilfully and thoroughly as Mr. Fron has dealt with sylviculture, the French landowners and farmers are thus endowed with an excellent, cheap, technical literature.

Mr. Fron is an inspector of the State forests, and professor of forestry at the National Forest School at Les Barres, where promising young forest guards are trained to become head-guards and forest officers in the State, communal, and private forests. The first edition of the book has been sold, and this new edition has extended the subject-matter, so as to form a concise, clearly-written book, suitable for the private landowner and his foresters. It is divided into three parts:—

(1) *The Forest and its Constituent Trees and Shrubs.* This gives an account of the life-history of a tree, and a description of its parts; a list of the native woody species of France, with their botanical characteristics, and the uses to which their timber may be put. Then come trees considered in groups, the effects of density of growth, or its absence, on their forms and on the soil. Different kinds of crops of trees, natural or artificial, indigenous or exotic, follow, and the effects of forests on the flow of water and on the soil of mountains are described.

(2) *Practical Sylviculture.* Methods of stocking the ground, artificial or natural. Human agency in its effects on forest soil and on tree-crops. Methods of felling. General ideas about working-plans (quite sufficient for the private owner). Cubage and combinations of woods. Daily work done by an average labourer in various operations. Protection of forests against man, animals (including insects), physical phenomena (fire, snow, gales, &c.); fungi, weeds, &c. Valuation of forests.

(3) Comprises a study of the types of forest that prevail in France and of their management.

The term *sylviculture* among French professional foresters means a limited part of forestry, dealing with the cultivations of forest trees, but not including valuation or working-plans. The author, being a professional forester, knows this well enough, but has extended the meaning of the term in the way it is understood by the French people, for, unfortunately, the latter have not adopted the old French term, "*foresterie*," which is more comprehensive than *sylviculture*, corresponding to our term *forestry*.

The book is well and logically written and up to date, and its forestry is quite sound, while the printing is well done, and though the plates are somewhat rough, owing to the smooth paper, they serve to illustrate the author's points, and he has performed his task in a masterly manner.

A book resembling Fron's sylviculture, dealing with British woodlands, is still a desideratum. Our works on forestry are either comparatively very expensive and above the heads of the estate forester, or are too sketchy and controversial to be real text-books. But it is doubtful whether any British author could afford to publish a book like Fron's at 5*s.* a copy, so as to place it within the reach of estate foresters. "Our Forests and Woodlands," by John Nisbet, costing 7*s.* 6*d.*, is still one of the best short accounts of British woodlands, and is beautifully though sparsely illustrated, but it does not possess the clear scientific arrangement, nor the completeness of Fron's book. "English Estate Forestry," by A. C. Forbes, as well illustrated as is Nisbet's book, costs 12*s.* 6*d.*, and though also an excellent book, is not sufficiently detailed to become an elementary text-book, nor does it give a satisfactory account of coppice-with-standards, which on the Continent is the only recognised method of producing large, broad-leaved timber other than beech that is within the range of private estate management.

W. R. Fisher.

PRACTICAL CHEMISTRY.

(1) *Exercises in Physical Chemistry.* By Dr. W. A. Roth. Authorised Translation by A. T. Cameron. Pp. xii+196. (London: Constable and Co., Ltd., 1909.) Price 6*s.* net.

(2) *Laboratory Methods of Inorganic Chemistry.* By Heinrich Biltz and Wilhelm Biltz. Authorised Translation by W. T. Hall and A. A. Blanchard. Pp. xv+258. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 12*s.* 6*d.* net.

(1) ACCORDING to the experience of the author of this laboratory guide to physical chemistry, the existing German works on the subject contain either too much or too little for the beginner, and he has, therefore, attempted to cater for the

student who is commencing to study the subject. To a large extent the book is based on the "Kleine Praktikum," arranged by Prof. Nernst for students of physical chemistry at the universities of Göttingen and Berlin. As such it presents many features of merit, but at the same time a lack of discretion in regard to the relative amounts of space devoted to the various sections of the subject detracts very largely from its value as a work for general laboratory use. Only nine pages, for example, are devoted to the chapter on chemical statics and dynamics, whereas twenty-two are taken up by that on the determination of density. Again, thermochemistry is liberally treated, while spectroscopic and electrolytic work are not dealt with at all. Apart from this lack of proportion, the subject-matter is carefully handled, and the exercises are in general well chosen. Special stress is laid on the application of physico-chemical methods in connection with quantitative analysis and the determination of the constitution of organic compounds. The translator has added a chapter on the construction and use of the thermostat, and also an appendix on the use of the electroscope in radio-active work.

(2) In consideration of the fact that preparative work in inorganic chemistry forms an essential part of the training of the modern chemical student, an addition to the rather scanty literature of the subject is not unwelcome. In this book the authors outline a course of laboratory work which is essentially synthetic in nature, and is designed to aid in acquiring a more adequate knowledge of inorganic chemistry than is to be obtained by practice in chemical analysis alone. It is intended primarily for those who have passed beyond the more elementary stage in their study of chemistry. Although this is the case, the experimental part of the book is set out in relatively complete detail, and, to assist in the study of the theoretical relations involved, brief discussions of a general nature are interspersed throughout the book.

The experiments, which involve the preparation of more than 200 substances, have been carefully compiled, and the processes have been tested in the authors' own laboratories.

Having regard to the meritorious nature of the contents of the book, it is unfortunate that the authors should have departed from the usual practice in the arrangement of their material. Instead of treating the compounds according to the periodic groups, they have chosen to base the classification upon the different types of combination. It is claimed that this arrangement results in a better comprehension of analogous methods of preparation and analogous properties, and a more intimate amalgamation of experimental and theoretical chemistry. The justice of this claim appears doubtful. On the other hand, the general impression created by the arrangement is that the experiments have been written down in haphazard order, with the result that closely related compounds are often widely separated. In these circumstances a re-arrangement of the material on the lines of the periodic table would add to the value of the book.

SCIENTIFIC METHOD IN GEOGRAPHY.

Macmillan's Practical Modern Geographies. (1) *A Geography of the British Isles.* By Dr. A. Morley Davies. Pp. xiv+358. Price 3*s*.

(2) *Practical Exercises in Geography.* By B. C. Wallis. Pp. xxiii+184. (London: Macmillan and Co., Ltd., 1909.) Price 2*s*. 6*d*.

(1) IN the "Geography of the British Isles," Dr. Davies introduces each section by a number of exercises with maps and statistics, so that pupils may have inferences of their own gleaning to help them to appreciate the descriptive portions of the book. This is an interesting experiment, and is carried out with considerable success, though chances are missed in the descriptive paragraphs which might have been used to teach rather more by appeal to the imagination. In that way, too, the work would have been made more valuable as a book for the pupils themselves to handle.

The subject is introduced through a brief survey of the British region as a whole, and then its tides and climate are considered, after which districts are studied in a regular sequence. It is characteristic of the district-study in this book that no attempt is made to define the districts in any exclusive fashion; they are chosen as geographical units, and the occasional overlapping only enhances the thoroughness of the survey.

London is of such unique interest, and shows in so many ways the influence of the past on the present geographical conditions that it might have been considered in more detail, especially from this point of view. A fuller account might also have prompted teachers in other centres to study their own towns in similar fashion, and thence to introduce local and practical considerations into their teaching. A large number of district maps and some good photographs, mostly illustrating physical features, enrich this book, and an alphabetical index of the abbreviated names used on the maps is a useful addition.

(2) "Practical Exercises in Geography" is a reasoned attempt to work out a continuous series of practical exercises, some of the nature of experiments, some "in the field," and some in the class-room. The course begins with the simplest rudiments of surveying, and leads up very effectively to the understanding of contour lines and the relief of the country, the United Kingdom being, of course, the chief object of study.

Following this are exercises on the factors of climate, and from the basis of the study of relief and of climate we proceed to vegetation and human activities. A less satisfactory chapter on rocks and minerals is inserted mainly for the purpose of drawing in the consideration of coal, iron, and other mineral products. The definition of metamorphic rocks as "rocks which were once 'water' rocks and have since been changed, usually by the action of heat," is objectionable.

The course should give a reasonable knowledge of British geography in a somewhat unusual fashion, but it is to be feared that the knowledge of other areas acquired here and there would not be satisfactory for any purpose unless woven into a more complete system by the teacher. An interesting experiment is the inclusion of additional exercises, which are based upon descriptions extracted from the volumes of the Highways and Byways Series. They are well chosen to illustrate the different types of English scenery, and should be a useful link between æsthetic appreciation and exact observation.

OUR BOOK SHELF.

Carburettors, Vaporisers, and Distributing Valves used in Internal Combustion Engines. By E. Butler. Pp. xi+176. (London: C. Griffin and Co., Ltd., 1909.) Price 6*s.* net.

MR. BUTLER has written an interesting book on a subject which hitherto has not had justice done to it; and he is to be congratulated upon his bold decision to devote a book exclusively to these matters of detail instead of compressing them into the small space that can be spared in books dealing with internal combustion engines in their complete form. It cannot, of course, replace the completer treatises, but it is an excellent adjunct to them and is evidently written by one who is thoroughly familiar with this side of the work.

The volume contains twelve short chapters, of which the first four are concerned with surface and spray carburettors for petrol and alcohol motors, carburettors capable of automatically adjusting the air and petrol supplies over a wide range of speed, and various types of vaporisers for use with the heavy oils forming the second distillate from petroleum. The remainder of the book includes descriptions of various forms of admission and exhaust valves used on all classes of internal-combustion engines, together with some discussion of methods of actuating, timing, and water-cooling them.

Mr. Butler is an inventor on these lines, and has made himself familiar with what others have done in the same field; thus there are illustrations of no fewer than fifty-two different kinds of carburettor and vaporiser. With so much study of these matters, we wonder to find that he is apparently unaware of the increasingly common practice with motor vehicles of using the heat of the exhaust gases to warm, not the mixture as a whole, but the air supply only. The warm air is then passed over the jet and all the other arrangements are as usual. At least equal economy is obtained in this way besides greater ease of fitting and a lowering of the prime cost. Even with so simplified a form of carburettor or vaporiser as this makes, it has been found that the cylinders do not require cleaning out at any more frequent intervals.

As regards the valve mechanisms, we are glad to find that the author has included a description of the Knight engine, and, further, that he has given a good deal of space to the discussion of sliding and rotary valves. We cannot but feel that the poppet type of valve is unlikely to be permanently used, and the author deserves our thanks for having taken us some steps along the road towards a better form of valve mechanism. Many motor manufacturers are working in the same direction, and there is no doubt that we shall soon be hearing of other suggested forms of valve. If the experience of extended use of the Knight engine is favourable, it will give great impetus to this development. With the largest forms of gas engine there are, of course, already many engines now running with complete success, using slide valve forms of control for either the admission or exhaust ports, or for both.

Cotton Spinning Calculations. By W. S. Taggart. Pp. xiv+335. (London: Macmillan and Co., Ltd., 1909.) Price 4*s.* net.

THE author of this excellent and beautifully printed text-book assumes that the reader has no special equipment beyond an elementary knowledge of arithmetic, and some acquaintance with the various processes of cotton manufacture and the technical nomenclature used in connection therewith. In the introductory chapter, he gives general calculations respecting the velocity ratio in wheel trains and belt gearing; the surface velocities of rollers and the stretching of fibres resulting from "draft"; the estimation of "hanks" and "counts"; and the force actions of levers. A set of exercises closes this part. In succeeding chapters the treatment is more direct and special. The various machines through which the material passes, from the Scutcher to the Ring Spinning Frame, are considered in detail. The author has had the assistance of the leading manufacturers of textile machinery in the cotton district, and is thus able to give diagrams, drawings, and tables of wheel teeth, showing very clearly with full details the mechanisms used in all the standard types of machines. The calculations are therefore based on numbers representing the best modern practice. A special chapter is devoted to the consideration of epicyclic or differential gears and the design of cone drums. Thus, by repetition, and by the wealth of illustration provided, no reader should fail to obtain a thorough insight into the action of the most complicated of the mechanisms. This kind of quantitative work is essential if a student is to have anything more than a superficial knowledge of the subject, and it will enable him readily to calculate the wheel changes, &c., necessary in order that a machine shall be able to cope with the varying demands made upon it.

The author concludes his very interesting volume with a number of useful tables and an index. Both author and printers are to be congratulated on the production of this admirable work, which should be in the hands of everyone, at home and abroad, who is interested in the practical working of textile machinery.

Proceedings of the Aristotelian Society. New series, Vol. ix. Pp. 259. (London: Williams and Norgate, 1909.) Price 10*s.* 6*d.* net.

OF the nine articles contained in this volume the most important are, perhaps, Prof. Alexander's essay on "Mental Activity in Willing and Acting," and Prof. Stout's rejoinder, "Are Presentations Mental or Physical?" The point at issue in these papers is one of fundamental importance for both psychology and the theory of knowledge, since Prof. Alexander's contention, to put it quite plainly, is that all mental activity consists solely of conation and feeling, or possibly, since it is conceivable that the feeling or affective side of mental life may be reducible to experience of successful and thwarted conation, of conations alone. Hence he refuses to admit the existence of such cognitive processes as have usually been supposed to be denoted by the names sensation, imagination, perception. On his view the *object* apprehended in all these processes is physical; the *process* involved is simply conation directed towards a specific physical object. It follows, of course, that if Prof. Alexander makes out his case, "presentations" must be deleted entirely from our account of the stuff out of which mind is made, and, in the theory of knowledge, any doctrine which assumes either that "we can only know our own sensations," or that, at any rate, we begin by knowing our sensations and have to infer from them the character of the physical realities which are their stimuli, must be erroneous. Prof. Stout's criticism appears to show that Prof. Alexander's doctrine cannot be sustained as it stands, but the fact that it can be put forward by a writer of such philosophical eminence is an interesting sign of the influence which Avenarius is at last beginning to exercise on British philosophy.

Very similar tendencies are revealed by Mr. A. Wolf's interesting paper on "Natural Realism and Present Tendencies in Philosophy." The interest awakened by Bergson's striking book "L'Évolution Créatrice" is witnessed to by Mr. Carr's disquisition on Bergson's theory of knowledge, and Mr. G. T. R. Ross's treatment of the satisfaction of thinking. Pragmatism, as one would expect, does not go unrepresented. Dr. Schiller inflicts one of those castigations which are becoming periodical with him on rationalism in a paper on "The Rationalistic Conception of Truth," and the subject also figures prominently in a so-called symposium on pluralism, in which different points of view are represented by Dr. Schiller, Prof. Muirhead, and the writer of this notice. The volume further contains an essay on "The Mutual Symbolism of Intelligence and Activity," by Mr. Foston, and a discussion between Prof. Bosanquet, Dr. Sophie Bryant and Mr. G. T. R. Ross on "The Place of Experts in Democracy."

A. E. TAYLOR.

An Introduction to the Study of Biology. By J. W. Kirkaldy and I. M. Drummond. Pp. iv+259. (Oxford: Clarendon Press, 1909.) Price *6s. 6d.*

THIS little book represents an attempt to deal, within the limits of some 250 pages, with the study of biology as exemplified primarily by the organisms prescribed in the syllabus of the Oxford and Cambridge Schools' Examination Board. The authors have, however, realised the deficiencies of the type system and endeavoured to "bridge over the gulfs" by brief accounts of, or references to, a considerable number of forms "allied" to the selected types. Thus Monocystis, Hæmamœba, Bacillus, Chromulina, Actinosphærium, Globigerina, Rhaphidococcus, Arcella, Euglena, Noctiluca, Stylonichia, Acineta, Desmids and Diatoms are all introduced as allies of the more familiar Protozoa, viz. Amœba, Saccharomyces, Sphærella, Vorticella and Paramœcium.

There is no doubt that a too rigid adherence to the type-system does produce a very disconnected idea of the animal kingdom, but we fear that the ordinary schoolboy will think that it is bad enough to have to make the acquaintance of the types without having to shake hands with so many of their relations. No fewer than sixteen types of animals and plants are dealt with in more or less detail, ranging from the Amœba to the dogfish, and from the yeast to the sunflower, besides chapters on the distinction between animals and plants, the life-history of the frog, and the physiology of the rabbit.

The book contains numerous illustrations, for the most part borrowed from very familiar sources; a few are original, but we cannot congratulate the authors very warmly upon these. The picture of a crayfish on p. 112 is extraordinarily crude. The book gives an enormous amount of information gathered from a very wide field, but it is far too concentrated to be inspiring, and the authors do not appear to have succeeded in putting the general principles dealt with in a very clear light. We hope it is intended to be read in connection with a course of practical work, but we have not been able to find any reference to the necessity for such a course.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The End of the *Beagle*.

IT is well known that Charles Darwin began to advocate his famous doctrine of evolution after his voyage on board H.M.S. *Beagle* as naturalist, in the course of which he went to South America, Africa, and Oceania, and founded the theory of natural selection; but it has been a matter of regret among men of science throughout the world that the famous old ship had passed out of sight. As the result of careful inquiries, however, by Mr. Shigetaka Shiga, a renowned geographer in Japan, it has now been ascertained what was the ultimate fate of the *Beagle*.

Mr. S. Shiga has told the story to the editor of the *Yorodzu Chōhō*, the most popular newspaper in Tokyo, as follows:—"While I was attending the Sapporo Agricultural School some twenty years ago, I read in the *Living Age*, an American literary magazine, that the *Beagle* had been sold in Japan. After my inquiry it was found out that the warship had been bought by the Lord Shimadzu, who had changed its name to *Kenkō-maru*. Afterwards it was purchased by the Naval Department, and kept as a training ship of the Naval School in Tsukiji, Tokyo; but I had then no intention of preserving the famous ship, and so took no notice of the matter.

"This spring I heard Englishmen were sorry at having lost all trace of the *Beagle* at the hundredth anniversary of the great naturalist's birth. I then applied to a steward of Prince Shimadzu, as well as Viscount Captain Ogasawara, to get fuller particulars of the ship. According to the record of the Prince, the *Kenkō-maru* was certainly the *Beagle* that had been built of teak at Liverpool; it was bought for 75,000 dollars in Nagasaki on July 23 in the first year of Gwanji (1864 A.D.). Viscount Ogasawara informed me of the same fact, and added that the Naval Department ordered several officials, Kawamura (the late Count Sumiyoshi), Masuda, and Satō, to receive the same ship from the Shimadzu clan at Shinagawa on June 13 in the third year of Meiji (1870). It was in existence as a training-ship in the thirteenth year (1880), and was re-named *Yeiji-maru* at Yokosuga in the fifteenth year (1882). It was in May of the twenty-second year that the ship was sold by auction for 3276 *yen* to the late Kikusaburo Oaki, the proprietor of the Oaki Ship-building Yard.

"After some inquiries about the *Yeiji-maru* at Oaki's, I learned that the ship had been broken up at the old Shinagawa Fort, and that her cabin had been preserved for three years, when it was lost sight of; but Mr. Keizo Oaki, the present owner, who superintended the breaking up of the ship as the engineer-in-chief, has had the kindness to make inquiry of the workmen engaged in the work. The result is as follows. A part of the ship was at length discovered. It was being used as a stand for stones which have been piled up near the temple of Suitengu, in the premises of the dockyard. Having been taken out, it was found to be a part of the ribs of the *Beagle*, 3·5 feet in length, 1·5 feet in breadth, and of teak. Thus a portion of the fragments of the famous *Beagle* has at last been found."

TOYOZI NODA.

Ichinoseki, Iwate, Japan, October 27.

The Maintenance of Forced Oscillations of a New Type.

IN a paper "On a Class of Forced Oscillations" published in the *Quarterly Journal of Pure and Applied Mathematics* (No. 148, June, 1906), Mr. Andrew Stephenson discussed mathematically a proposition which may be stated in his own words thus: periodic non-generating force acting on a system in oscillation about a position of stable equilibrium exerts a cumulative action in intensifying or diminishing the amplitude, if its frequency is contained within any one of a number of ranges lying in the vicinity of 2μ, $2\mu/2$, $2\mu/3$ . . ., where μ is the natural frequency of the system.

Further investigations upon this and other allied subjects appear in seven subsequent issues of the *Philosophical Magazine*. As regards the forced oscillations discussed in the *Quarterly*, the author gives, in the way of experimental verification of his mathematics, the following:—the influence of the disturbing motion becomes feebler as r increases, but it may easily be observed experimentally in a number of cases. For this purpose suspend a load by means of a spiral spring, and attach to it a pendulum light compared with the load, but of such density that the air resistance is negligible; the pendulum being of suitably chosen period, it will be found that when the load is carefully adjusted the relative equilibrium of the pendulum in the vertical motion is unstable.

I believe the beauty and interest of the results obtained by Mr. Andrew Stephenson have not been generally realised, otherwise it is nearly certain that something more satisfying in the way of experimental demonstration of these oscillations than mere observation of "instability of equilibrium" in certain cases would have been put in the field. I think an experimentalist would hardly be pleased with anything less than the actual permanent maintenance of oscillations of the type mentioned, *i.e.* something similar to the experiments of Faraday, Melde, and Lord Rayleigh for the case of double frequency, which, as Mr. Stephenson points out, is only one particular case of his general theorem.

During the course of certain acoustical work which I have been engaged in during the last two years, I observed certain types of stationary vibration which I find are undoubtedly of the kind contemplated in Mr. Stephenson's paper. These observations were made with an apparatus from which any new effects were apparently hardly to be expected. The arrangement was the well-known one of a string maintained in vibration by a tuning-fork oscillating in a direction parallel to the string. It is generally supposed that the oscillations permanently maintained have a frequency which is half that of the tuning-fork. I found this was *not* always the case. With an electrically maintained tuning-fork the amplitude of oscillation of which could be readily adjusted, the stationary oscillation of the string had a frequency of $\frac{1}{2}$ of, equal to, 3/2 times, twice, &c., that of the tuning-fork, each term in the harmonic series appearing separately by itself with a fairly large amplitude, or with one or more of the others conjointly, according to circumstances. The frequency- and phase-relations could be studied by several methods, most of which were very simple applications of the principle of Lissajous's figures.

The possibility of isolating the harmonics, and also certain serious discrepancies between theory and experiment as regards the phase of the oscillations in the case of double frequency, were traced to the existence of variations of tension in free oscillations of sensible amplitude. These variations of tension were experimentally demonstrated by a special form of monochord denominated the "Ectara" (*vide* the Journal of the Indian Mathematical Club for October, pp. 170–5), in which the sounding surface is a membrane perpendicular to the vibrating string, and emits a tone having *twice* its frequency.

Post-Box 59, Rangoon. C. V. Raman.

Absorption-bands in Colourless Liquids.

In the obituary notice of the late Dr. W. J. Russell, F.R.S. (Nature, November 25, p. 101), whose genial friendship I enjoyed and with whom, when occasionally in London, I had friendly intercourse, it is stated that he had published "papers conjointly with Mr. Lapraik on absorption spectra, and notably one on the absorption bands in the visible spectra of colourless liquids, which was the pioneer paper in a branch of inquiry that has been ably followed up by Prof. Noel Hartley, F.R.S., Mr. E. C. C. Baly, F.R.S., and others." It seems ungracious to call in question the accuracy of this reference, and I feel, indeed, a great inclination to let it pass without comment, although it is incompatible with authoritative statements made elsewhere; but, inasmuch as the passage is liable to be reprinted without question and repeated in other publications, I consider it would be better to invite the writer's attention to the Chemical Society's Transactions, xxxix., 153–68, 1881, "Researches on the Relation between the Molecular Structure of Carbon Compounds and their Absorption Spectra," and suggest that he should compare it with the paper which follows in the same volume, pp. 168–73, "On the Absorption-bands in the Visible Spectrum produced by Certain Colourless Liquids." Having done so, I think he will agree that not only is the latter not the pioneer paper, but also that there is very little in common between the two. In fact, the latter communication is more closely allied to the work of Abney and Festing in the infra-red region, a work to which the authors themselves make a special reference.

W. N. Hartley.

Royal College of Science, Dublin, November 30.

The Inheritance of Acquired Characters.

In his review of Prof. Poulton's work, "Charles Darwin and the Origin of Species," Prof. Meldola says (Nature, November 25, p. 92) that the Darwinian theory is absolutely dependent upon the truth of the belief "in the transmissibility by inheritance of individual differences or 'fluctuations.'" This is undoubtedly true. There is now available a vast amount of evidence tending to show that "fluctuations" seemingly the direct results of changes in the environment are inherited; but how is it possible to convince Weismann and his followers that such "fluctuations" have not been due, as they will say, to "spontaneous germinal variations"? Surely the *onus probandi* really rests with them!

We have here the question of the inheritance or not of acquired characters reduced to its simplest terms. There is much and very varied evidence to show the influence of changes in the environment in producing "fluctuations" which are heritable, but what evidence can those who disbelieve in the inheritance of acquired characters present to show that in all such cases there *must* be a primary germinal change? H. Charlton Bastian.

The Athenæum, November 26.

Luminous Night Clouds and Aurora Spectrum.

On the evening of Friday, December 3, there occurred a very brilliant display of luminous night clouds in rather peculiar circumstances. During the earlier part of the evening the sky had been clear, and no indications of an aurora were observed. About 10.15 p.m. the sky became completely overcast quite suddenly, and it was noticed that this appeared to be by general formation of haze *in situ*, and not by the drifting of clouds. Almost immediately after this numerous patches of light cloud appeared, travelling with considerable velocity eastward. From numerous previous experiences it was at once apparent that these were not ordinary cloud forms, and the moon was not high enough to account for their extreme brilliancy. Careful examination with a hand spectroscope confirmed the surmise that they were luminous clouds, the green auroral line being very bright and sharply defined; on several of the brighter masses other lines were suspected, but not sufficiently well to assign any position. These observations were confirmed by Mr. W. Moss. At about 10.45 p.m. the clouds gradually became less frequent, and the sky became clear again almost as suddenly as it had been overcast.

It will be of interest to hear if any magnetic storm has been recorded for this epoch. The surface of the sun has been in continued disturbance during the past week, as evidenced by the rapidly changing forms of numerous spots. One of the largest groups would be passing round the north-west limb. Charles P. Butler.

Solar Physics Observatory, London, S.W.

Coloration of Birds' Eggs.

Some time ago I wrote a short letter asking for information about the colours of birds' eggs, which appeared in Nature of May 14, 1908. I read the answer to my letter in a subsequent number of Nature, which, unfortunately, did not appear to me to throw much light on the subject.

I would like to suggest that this colouring of eggs was in some way originally analogous to the change of colour observable in the chameleon and certain lizards, though by no means at the same level of development. Although it is quite possible that the colouring in some cases is protective, or has become so, it does not seem that this is a fixed rule. Why should the egg of a starling, which generally builds on house-tops, be blue? The hedge-sparrow's, again, is blue, while the thrush's is blue spotted with black, and the blackbird's is green, though the position of their nests is vastly similar. Again, on examining the excellent "clutches" at the Natural History Museum which exhibit the additional cuckoo's egg, one is struck by the variation in shade, which, according to observers, is matched by the bird itself.

It seems to me that the elucidation of this problem would be of great value in such vexed questions as the inheritance of acquired characteristics, and might be really illustrative of the exact processes of evolution. R. L. LESLIE.

13 Electric Mansions, Brixton, S.W., December 1.

The Terminal Velocity of Fall of Small Spheres in Air.

AT the recent Winnipeg meeting of the British Association we presented some results on the terminal velocity of fall of approximately spherical spores, which were not in agreement with Stokes's formula (see NATURE, October 14, p. 472). We have succeeded since in making minute spheres of paraffin wax, a certain black wax, and mercury, and have determined their terminal velocities over a wide range of sizes by the same method as in the preceding investigation. The velocities obtained for these spheres are in close agreement with Stokes's formula. The reason for the deviations in the former cases is not clear.

JOHN ZELENY.
L. W. MCKEEHAN.

University of Minnesota, November 23.

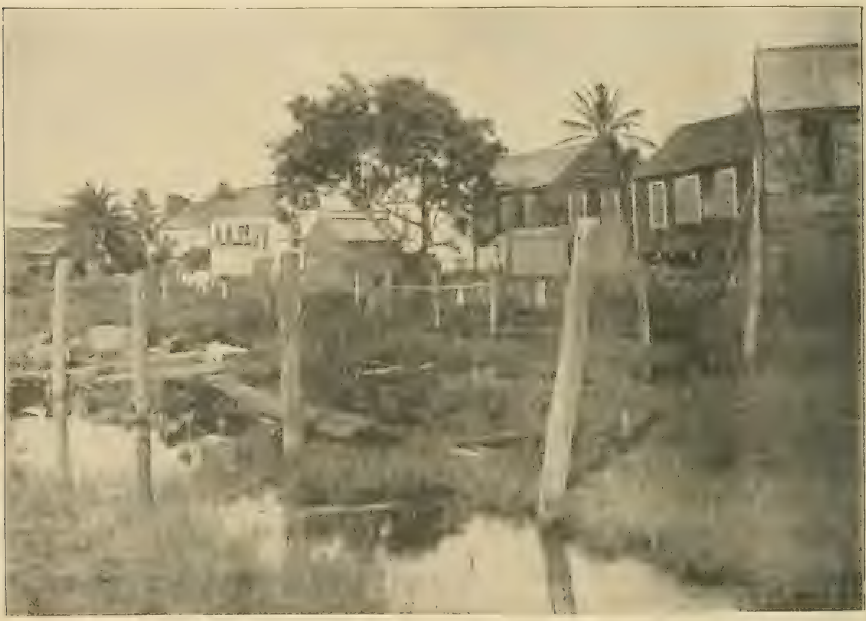

FIG. 1.—Water-logged Anopheline Breeding Land, Belize. From "Mosquito or Man?"

THE PROPHYLAXIS OF TROPICAL DISEASES.

THE history of tropical medicine, or what might be called its recent twentieth century renaissance, will go down to posterity as one of the most remarkable chapters in medicine. In a book entitled "Mosquito or Man? The Conquest of the Tropical World,"[1] Sir Rubert Boyce endeavours, in his own words, to epitomise this wonderful movement, a movement initiated in England by the then Secretary of State for the Colonies, Mr. Joseph Chamberlain, and by Sir Patrick Manson, a physician who had practised in the East, and had returned home imbued with the idea that the diseases of the tropics stood, so to speak, by themselves, and thus required special teaching in the medical schools of this country. The idea gained ground; two tropical schools, one in London, one in Liverpool, were founded, as Sir Rubert describes in his first chapter, and from that day onwards things have never looked back. Discovery after discovery have poured from these schools until now we stand on the threshold of a new world, a tropics as healthy as a temperate clime.

There apparently is nothing new under the sun, not even in medicine; the author describes in his fourth chapter how Sir Henry Blake, when Governor of Ceylon, had been shown a medical work written fourteen hundred years ago, in which the mosquito was stated to be a carrier of disease, and in which malaria was described as being transmitted by flies or mosquitoes—a truly prophetic utterance. More recently than this certainly, but yet, as things go now, of older times, Beauperthuy, in 1853, practically said the same thing, and had he but had a disciple of the worth of Ross the thing would have been settled long ago, and the gain to humanity have been the saving of millions of lives. Unfortunately, neither he nor King nor Finlay could prove the truth of their assertions, so it was left for Manson to revive the view once again, and this time at last a worker—Prof. Ross—came forward, and by a brilliant piece of research work solved the mystery once and for all. Long before this, Manson had also shown that the *Filaria bancrofti* underwent a metamorphosis or development in the tissues of a mosquito, and Low had subsequently proved—not Manson, as the author erroneously states on p. 36—that after this development was complete, the parasites found their way into the proboscis, and so got back to man when the insect bit again.

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[1] "Mosquito or Man? The Conquest of the Tropical World. By Sir Rubert Boyce, F.R.S. Pp. xvi+267. (London: John Murray, 1909.) Price 10s. 6d. net.

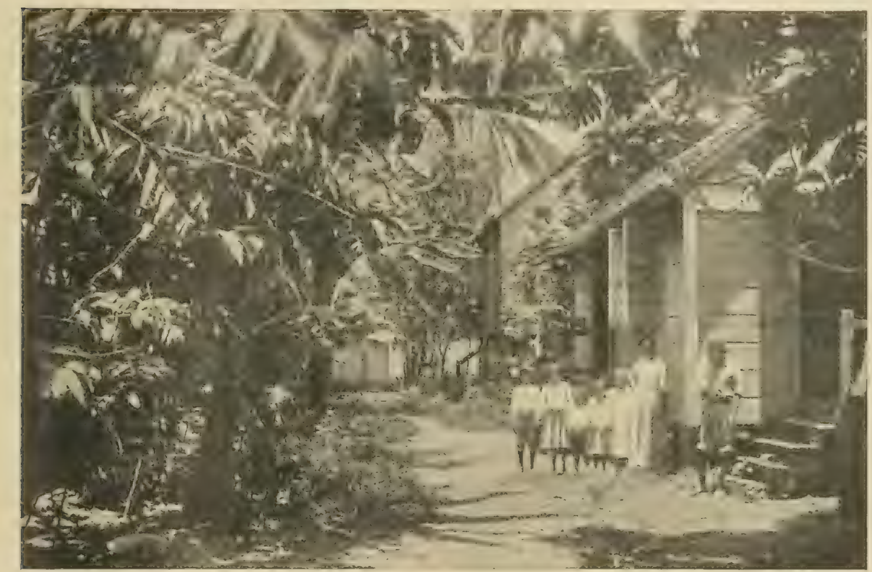

FIG. 2.—Too much Bush. Georgetown, Demerara. The effect is to obscure Sunlight and Fresh Air. From "Mosquito or Man?"

The Americans in Havana, profiting by Ross's work on malaria in the mosquito, tried mosquitoes for yellow fever, and by a series of experiments proved that a mosquito, the *Stegomyia calopus*, is the sole agent in the transmission of this disease. Here, then, were three of the most important tropical diseases clearly proved to be carried by mosquitoes, and, the cause having been ascertained, there only remained the question of prevention. How difficult it is to break down old traditions, and the antagonism that was displayed to the men of science who were sent out to preach the new doctrines are well brought out in chapter iii.; even to the present day there are members of the medical profession who disbelieve in the mosquito, *vide* p. 118. Ross at once, after his researches on the development of the malarial parasite in the mosquito, advocated a war against these insects as being the rational method of cutting the cycle and stamping out the disease, and his original campaigns and subsequent ones—Ismailia, for example—are samples of what may be done. He has complained at times of the slowness with which this new sanitation has moved in some of the British Colonies, and certainly, as compared with American dependencies, it has been slow; but now, as chapters viii. and xiv. of "Mosquito or Man?" show, the movement is advancing, most of the West Indian islands, terrified by the fear of yellow fever, the scourge of these parts, having now got definite ordinances and regulations dealing with the question of breeding grounds of mosquitoes.

The historical survey of yellow fever contained in chapter xi. gives an idea of what these places were like in the old days, Fergusson telling how 1500 soldiers had perished in one epidemic, while in another instance the Secretary for War in England wanted to know from the Governor of British Guiana why in a few months 69 per cent. of the white troops had perished. The churchyards of Barbados and the other islands are full of the bones of the victims, and it is said of the slopes of the Morne in St. Lucia that there is not a square yard without the remains of a soldier under it, more being there from the results of yellow fever than from the bullets of the enemy. Now what do we find? Let us refer to chapter xiv., which contains an account of the anti-yellow fever campaign in Havana, 1900. As Sir Rubert says, "This will always remain one of the first and one of the greatest examples of what has been done to stamp out a disease by concerted intelligent action, and using the latest and most modern weapons. When the American Government took over the administration of Cuba, one of the first things to be done was to make Havana a livable place. Hitherto it had been notoriously unhealthy, 35,952 persons perishing of yellow fever between the years 1853–1900, this being equivalent to 754 a year, 64 a month, or to 2 deaths a day;

and now, after General Woods, Colonel Gorgas, Guiteras, Finlay, and others took the situation firmly in hand, and organised a thoroughly efficient sanitary administration and a special raid upon the breeding places of the Stegomyia, the death-rate for Cuba has come down to between 11–17 pro mille. In 1907, only one case of yellow fever was reported in Havana."

Panama, New Orleans, and every other place treated in a like manner have given similar results, and certainly no sane individual will be found who, after reading "Mosquito or Man?" will deny that the mosquito is the only transmitter of yellow fever, and the remarkable results that follow its destruction.

Equally remarkable are the results that follow the extermination of anophelines for malaria. It was computed that Ismailia (p. 65), already mentioned, in 1886 had every inhabitant infected. Ross began his anti-malarial campaign there in 1901; by 1904 the cases were diminishing fast, until in 1905, 1906, 1907, and 1908, there were no new cases at all, indicating that the disease had been entirely stamped out. One would like to multiply further examples, but space forbids; those desiring more must read the book for themselves. There is little to criticise adversely in the work. Of omissions one might notice what was the first anti-malarial and yellow-fever campaign in the West Indies, namely, that conducted on the Morne and Vigie in St. Lucia in the year 1901, and also the pioneer work done on the destruction of mosquitoes for filariasis in Barbados.

Of errors, on p. 128, in the sentence "then after a latent period of three days the Stegomyia," &c.—should manifestly read "thirteen" days. On p. 133, "Man suffering from yellow fever after the fifth day is the reservoir" should read "Man suffering from yellow fever on the second or third day or before the fifth is the reservoir."

The book is clearly and ably written, is most interesting to read, is nicely illustrated by beautiful photographs, and we cannot do anything but praise the author for its production.

INDUSTRIAL EDUCATION.

TECHNICAL education may be regarded as falling naturally into two main divisions, (1) the education of the higher ranks of those engaged in industrial work, and (2) the education of the rank and file. From time to time one or other of these divisions occupies the more prominent place in the public interest. Recently, probably as a result of the discussions following the publication of the reports of the Poor Law Commission, special prominence has been given in the Press and elsewhere to the problem of the industrial education of those who will become in the near future the skilled workmen, artisans, and craftsmen of this country. Two recent attempts to influence public opinion in this matter may be here briefly recorded. Probably the more useful of the two is an attempt to organise a National Industrial Education League, the main object of which, in the language of its promoters, is "to make elementary education go hand in hand with industrial training, and to stop the criminal waste of the nation's best asset by giving our boys, before leaving school, a sound elementary industrial training." This proposal "has already received the approval of fifty-seven trades' councils, and of the representatives of 3,000,000 of industrial workers." In addition, promises of support have been received from many large employers of labour, distinguished educationists, and well known public men. Special stress is laid upon the fact that, "while the present system of technical education has benefitted many, it has left uncared for, and can never reach, the bulk of the children who are destined to become industrial workers."

The second recent noteworthy attempt to arrive at some definite agreement in the matter was a conference held on Friday, December 3, at the Mansion House, at the invitation of the Lord Mayor, to consider (1) the development of industrial training in both elementary and trade schools, and (2) the organisation of facilities for bringing boys and girls who are leaving the public elementary schools into better touch with the openings that exist in the industrial and commercial world. The conference was attended by a number of representatives of the London County Council Education Committee, many large employers of labour, and delegates from trades unions. It is probable that the London County Council, at whose suggestion the conference was called, will not profit much by the deliberations of the conference. As no definite resolutions were submitted for discussion, there was a tendency to neglect general principles and treat side-issues only. Running throughout most of the speeches, however, was a belief in the impossibility of reviving the old system of apprenticeship and the consequent necessity for some form of educational work to give the necessary industrial training formerly supplied by the apprenticeship system.

Interest in industrial education is now extending to the political parties. Thus the National Union of Conservative and Constitutional Associations, at its recent annual meeting in Manchester, passed a resolution urging

> "that the Conservative leaders at once push forward a scheme of development of technical, scientific, and agricultural education for Great Britain and Ireland, and that this scheme must be linked with the system of primary education."

On the other side of the political platform, the Labour party has passed resolutions at recent conferences demanding a free national system of primary, secondary, university, and technical education. At the forthcoming annual conference of the Labour party to be held in January, 1910, the conference will be asked

> "to observe the increasing tendency to make use of boy and girl labour in monotonous and uneducational industrial work as fatally destructive in its results upon the health, character, and subsequent industrial efficiency of the boys and girls themselves . . . and to urge upon the Government the desirability of so amending the Factory and Education Acts as to secure to every boy and girl between the ages of fourteen and eighteen efficient physical and technical training."

As the question of industrial education is one which affects the working classes more than any other section of the community, it is obvious that any future legislative action on the matter will be considerably influenced by expressions of opinion from bodies such as the Labour party and the trades unions. There is a danger that organisations of this type may be tempted to use their influence to give an unduly utilitarian bias to the education of boys and girls in the elementary and continuation schools. This danger is, however, more apparent than real, as is shown by (1) the vigorous support given by trades unions and similar bodies to the Workers' Educational Organisation, the object of which is to secure university education in literature, history, political economy, and the like for working men, and (2) the general undercurrent of opinion among workmen that the financial benefits of trade and technical education will ultimately fall to the employer and not to the workman.

At the present time much controversy is taking place respecting the question of apprenticeship. Is it desirable to revive the system of apprenticeship, and if desirable, is it possible to do so? The general trend of opinion at the present time is that, except for certain isolated trades, a revival of the apprenticeship system is both undesirable and impossible. Apprenticeship gives manual dexterity, but not the general industrial knowledge and intelligence which will enable the boy to adapt himself to changing industrial conditions. Hence it is desirable to make the necessary provision for compulsory education in the principles of different trades. The chief suggestions for effecting this are as follows:—(*a*) that the "leaving age" should be raised to fifteen years, the later years of school life being given partly to continuing the general education of the boy or girl, and partly to manual, scientific, and industrial work; (*b*) the establishment of "trade schools" for boys of from thirteen to sixteen years, giving about fifteen hours per week to class-room work in science and English, and about fifteen hours per week in the workshops; (*c*) compulsory attendance, for about twelve or more hours per week, at day or evening continuation schools for all young persons engaged in industrial work.

The movement for the spread of industrial education among the mass of the population of this country merits the support of the scientific world because of its bearing upon the general intellectual development of the nation as a whole, if that industrial education be framed upon sufficiently broad and generous lines. National progress, whether industrial or scientific, depends upon two main agencies—the organiser or leader and the skilled subordinate. University and higher technical education will produce the first of these, but the second will only be forthcoming in sufficient quantities through the operation of a broad general scheme of industrial education.

J. WILSON.

NILOMETRY.[1]

IT is the common fate of the ancient gods of flood and field in these sternly practical days to find their empires gone, their sceptres dishonoured, and even their personal liberty endangered. The Nile is no exception to the rule. The old age of the river of Egypt finds his fitful temper curbed, his moods controlled,

> ". . . all his faults observed,
> Set in a note-book, learned and conned by rote."

Where he was master, he has become a slave. Where he ruled, he must now learn to obey.

Such are the reflections induced on turning over the pages of a report, recently issued by the Egyptian Survey Department, dealing with the measurement of the water discharged by the Nile. The patient, persistent efforts of a Governmental bureau are gradually transforming the excesses of a capricious river into quiet and orderly processes adapted in every way to the agricultural needs of the country through which it flows. The construction of the Aswan Dam constituted the first great epoch-making achievement in this direction, and it is being followed up by a series of systematic observations of the regimen of the river which will throw light upon many obscurities in its phenomena, and enable further steps to be taken for its improvement.

The Nile, as is now generally known, is fed almost exclusively by the rain which falls over two elevated areas, the equatorial plateau of Central Africa and the Abyssinian plateau. These two sources act in very different ways, the first affording a relatively small but continuous supply, and the latter, copious but intermittent increments, producing the regular flood effect upon which, until quite recently, the agricultural prosperity of the country depended.

The admeasurement of the variation in the volume of water which is thus discharged necessitated the establishment of a gauging station, and the report states that, on grounds of expediency, a site was chosen at Sarras Old Fort, a little above Wadi Halfa. Here the necessary plant and apparatus were installed. It would take too long, however, to recapitulate, even succinctly, the dispositions which were made and the manner in which various local obstacles were overcome. These were duly related in the report, and the results of the observations taken are tabulated in part ii. of the volume. They include the mean velocity and cross-sectional area of the stream on successive dates, also a chemical analysis of the water and the percentage of mud in suspension. A third section gives a brief mathematical account of various rating formulæ for current meters.

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[1] "Measurement of the Volumes Discharged by the Nile during 1905 and 1906." By E. M. Dowson, with a Note on Rating Formulæ for Current-meters, by J. I. Craig. Egyptian Ministry of Finance. Survey Department Paper, No. 11. Pp. 82. (Cairo: National Printing Department.) Price 100 millièmes.

NOTES.

WE regret to see the announcement of the death, on December 5, of Prof. H. Bauerman, at seventy-five years of age. The funeral will take place at Brookwood Cemetery on Friday, ember 10.

PROF. A. C. SEWARD, F.R.S., professor of botany in the University of Cambridge, has accepted the invitation of the executive committee of the Yorkshire Naturalists' Union to be president of that society for the year 1910.

THE council of the University of Paris has, we learn from the *Revue scientifique*, passed a resolution to the effect that monuments intended to commemorate men who have brought distinction on the University of Paris since 1808 shall be erected in the church of the Sorbonne. This honour will be awarded on the decision of the council, by a majority of two-thirds, not earlier than ten years after the decease of the person concerned.

WE notice with regret the death of Dr. Jean Binot, on November 25, at the age of forty-two years. Dr. Binot had charge of one of the laboratories of the Pasteur Institute of Paris. Before taking up the study of bacteriology he was associated with astronomy. In 1901 he had charge of an expedition for the study of the transit of Venus, and in connection with this work he was awarded the Janssen prize of the Paris Academy.

AN appeal is being made to the Treasury for funds to complete the publication of the scientific reports of the voyage of the *Scotia*. It appears that the Scottish expedition is the only one of the recent Antarctic expeditions—British, Belgian, German, French, Swedish, and Argentine—that has not received Government help. The appeal is made by the committee of the Scottish National Antarctic Expedition through its honorary secretary, Mr. J. G. Ferrier. An additional grant is asked for beyond the funds for publication, to enable Dr. Bruce to reimburse those who have advanced money beyond their regular subscriptions to the expedition.

THE following are among the lecture arrangements at the Royal Institution before Easter:—Mr. W. Duddell, a Christmas course of six illustrated lectures on modern electricity, adapted to a juvenile auditory: (1) first principles; (2) electrical instruments; (3) Röntgen rays; (4) the generation of electricity; (5) electric oscillations; (6) electric lighting; Prof. W. A. Herdman, three lectures on the cultivation of the sea; Rev. C. H. W. Johns, two lectures on Assyriology; Prof. F. W. Mott, six lectures on the emotions and their expression; Prof. Silvanus P. Thompson, three lectures on illumination, natural and artificial; Sir J. J. Thomson, six lectures on electric waves and the electromagnetic theory of light. The Friday evening meetings will commence on January 21, when Sir James Dewar will deliver a discourse on light reactions at low temperatures. Succeeding discourses will probably be given by the Rev. Canon Beeching, Prof. W. Bateson, Mr. C. E. S. Phillips, Prof. H. H. Turner, Lord Rayleigh, Dr. C. Chree, Dr. H. Brereton Baker, Sir J. J. Thomson, and other gentlemen.

The death is announced of Dr. T. Nishikawa, of Tokyo, for a number of years an associate of Dr. Kishinouyé in the Imperial Fisheries Bureau in Tokyo, and later a special investigator of pearls. Writing in *Science*, Prof. Bashford Dean says that Dr. Nishikawa was distinguished as the discoverer of a process by which the pearl oyster may be caused to secrete spherical pearls. Before this only hemispherical pearls had been produced, in spite of centuries of experimentation, especially in the Orient. Dr. Nishikawa devoted nearly ten years to his studies on producing pearls, and achieved success only in the days of his final illness. In his memory, and in token of the importance of his discovery, a number of his living pearl oysters were taken to the University of Tokyo on the occasion of the late graduation ceremony; they were opened in the presence of the Emperor, and Prof. Iijima demonstrated that their mantles had secreted spherical pearls. The publications of Dr. Nishikawa include important contributions to our knowledge of Japanese fishes, structural, systematic, and embryological. Especially to be recalled is his pioneer paper on the development of the remarkable frilled shark, *Chlamydoselachus anguineus*.

The Dick Institute, Kilmarnock, a gift to his native town from the late James Dick, of the Greenhead Gutta-percha Works, Glasgow, was destroyed by fire on the evening of November 26. The building, which cost about 15,000*l*., consisted of a public library and museum. The latter contained the very valuable collection of Carboniferous fossils which belonged to the late James Thomson, of Glasgow; a splendid collection of silurians, antiquities, &c., presented by the late Dr. Hunter-Selkirk, of Braidwood, Lanarkshire; and a very handsome collection of native birds presented by the Kilmarnock Glenfield Ramblers' Society, together with numerous other articles of great scientific value. Mr. H. Y. Simpson, librarian of the institute, informs us that the whole of these have been destroyed by the fire, and the loss is looked upon as irreparable, particularly so in the case of the Thomson collection of corals and reptiles, many of which were type-specimens, and therefore regarded by geologists as quite of incalculable value.

The annual general meeting of the Royal Agricultural Society of England was held on December 8, when various reports, including that of the council, were considered. The council's report shows that the total number of governors and members on the register is 9920. The show of 1910 will take place in Liverpool on the Wavertree Playground from June 21–25. We notice that prizes to the value of 450*l*. are offered for the best managed farms in four classes, duly specified in the report, the competition being confined to tenant farmers resident in Lancashire and Cheshire. The society is also offering a gold medal for the best agricultural motor. A pleasing increase in the number of samples analysed in the society's laboratory is recorded, the number for the last twelve months being 475, as against 410 in 1908. The work at the Woburn Experimental Farm and Pot-culture Station has progressed well. The field experiments have included an extensive series on the relative value of the new nitrogenous manures, calcium cyanamide and calcium nitrate, in comparison with ammonium sulphate and sodium nitrate; also a further trial has been given to "nitro-bacterine" and other methods for inoculating leguminous and other crops, and the experiments with magnesia on different field crops have been carried a stage further. Satisfactory work is reported also in the botanical and zoological departments.

An article upon "The Danger of the Comet," contributed to the December number of *Pearson's Magazine* by Mr. E. C. Andrews, contains some interesting particulars—popularly expressed—relating to Halley's and other comets, and an imaginative description of the consequences of a collision between the earth and a comet. As nothing is definitely known about the size of the meteorites which probably form a comet's head, the result of the earth passing through the head is problematical. If the head is merely a condensed swarm of cosmic dust particles, there would be a fine shower of shooting-stars, but if the meteorites in it weigh tons instead of grains or ounces, the consequences of a collision with it would, of course, be serious. The tail of a comet is, however, so extremely attenuated in its nature that even if it consists of poisonous gases our atmosphere is not likely to be appreciably affected by it. To describe the tail, as Mr. Andrews does, as a "dense stream of fiery fragments" is, to say the least, misleading. No comet has a mass which is as much as the hundred-thousandth part of the earth's mass; in other words, the total mass of any comet is less than that of a ball of iron 150 miles in diameter. The fall of a comet into the sun would, therefore, not produce more heat than the sun radiates in eight or nine hours. As Prof. C. A. Young remarked, when referring to the possibility of this event, "there might, and very likely would, be a flash of some kind at the solar surface as the shower of cometary particles struck it, but probably nothing that the astronomers would not take delight in watching." It is desirable to remember facts like these when speculating upon the subject of danger from comets.

The report of the committee of the Warrington Museum for the year ending at Midsummer last records the additions to the collection during the year. The curator ought to be aware that *Vespertilio auritus* is not the proper designation for the long-eared bat.

In a paper published in the *Boletin de la Instrucción Pública*, Buenos Aires, Mr. R. Sinet gives an illustrated summary of Dr. Ameghino's views with regard to the pedigree of the human species, especially dwelling on the supposed evidence of the evolution having taken place from marsupial-like ancestors in South America itself.

In vol. xl., part i., of the *Comptes rendus de la Société Impériale des Naturalistes de St. Pétersbourg*, Mr. G. Nilus describes two polyzoans, *Loxosoma murmanica* and *L. brumpti*, collected in Kola Fjord, on the Murman coast, where they occurred in great profusion, accompanied by other polyzoans and the gephyrean *Phasiolion spitzbergense*.

The first two articles in the January-June issue of the *Sitzungsberichte und Abhandlungen* of the Dresden Institute are devoted to subjects connected with Darwinism and Darwin, Dr. E. Kalkowsky dealing in the former with the geological foundation of the doctrine of evolution, while in the latter Prof. O. Drude discourses on the theory of the origin of species, and especially the publication of the famous volume bearing that title, as a land-mark in the life of Darwin.

According to a paper by Mr. L. B. Taylor, published in the October number of the Journal of the South African Ornithologists' Union, Verreaux's eagle (*Aquila verreauxi*) constructs its nest in Cape Colony entirely of the green boughs of a rough bush, which must be very difficult to break off. The only other instance of the use of similar material for nest-making occurs in the case of the African *A. wahlbergi*, where it is used as lining. *A. verreauxi* preys, to a great extent, on hyraxes, numerous remains of which were found in the nest examined by Mr. Taylor, but also hunts and kills a certain number of klipspringers.

The latest issue (vol. vi., anno 3) of *Rivista di Scienza* contains three articles on geological subjects, Prof. L. de Marchi dealing with mountain-formation, Prof. F. E. Mess contributing the second instalment of an interesting article on modern theories of volcanic action, and Messrs. P. Enriques and M. Gortani discussing the succession of geological periods. The last-named article is of a somewhat remarkable character, as the authors deny the existence of any such definite periods. They do not, however, propose to abolish the generally accepted geological classification, which they consider necessary for the convenience of study, but content themselves with pointing out its purely artificial character.

The important subject of the working of teak forests comes in for discussion in the *Indian Forester* (October). Mr. J. F. Troup, the imperial superintendent of forest working-plans, recommends measures for improvement fellings in the Burma forests associated with burning of undergrowth to help natural reproduction and produce even-aged crops. With reference to the mixed teak forests in the Central Provinces, where the system is coppice with standard, Mr. C. M. McCrie points out that information is wanting as to the longevity of coppiced stools and coppice shoots, also as to the fertility of seed produced by the latter.

For many years coffee plantations in Central America have suffered from the attacks of a parasitic fungus which is said to be almost as dangerous as its better known eastern congener, *Hemileia vastatrix*. Little information has been available concerning the life-history of the fungus except the production of a conidial stage on diseased leaves, shoots, and fruits, to which Cooke gave the name *Stilbum flavidum*. Mr. G. Massee now records in the *Kew Bulletin* (No. 8) that he has obtained an ascus-forming (Nectria) stage, which transfers the fungus to the genus Sphærostilbe. Unlike the conidia, the ascospores readily produce infection in healthy leaves, leading to the formation of the customary white spots and conidiophores.

A study of the phytoplankton gathered in the North Atlantic Ocean affords a great deal of variation, as will be realised from the results published by Mr. W. Stüwe in Engler's *Botanische Jahrbücher* (vol. xliii., part iv.). From Dover to Brest the plankton is coastal, and consists almost entirely of diatoms, with a preponderance of species of Coscinodiscus and Biddulphia. Thence to the Azores species of Ceratium abound in the deeper waters, but in the neighbourhood of the Canaries the increase of Bacillariaceæ betokens an influx of coastal forms. Around the Cape Verde Islands Trichodesmium is dominant in the equatorial currents. Another type of vegetation is met with in the Sargasso Sea, in which species of Ceratium, notably *Ceratium tripos protuberans*, are common. With regard to vertical distribution, in the colder waters the Bacillariaceæ predominate at the surface, while the Peridineæ occur in the next zone; in the warm seas the Peridineæ lie at the surface, and the diatoms are found below.

The results of manurial experiments on the sugar-cane, carried out at the Experiment Station of the Hawaiian Sugar-planters' Association, have just been issued (Bulletin No. 29). The results could not be correlated with the chemical composition of the soil as determined by the ordinary methods of analysis or by the aspartic acid method first used in Hawaii, and the author concludes that the profit resulting from the application of manures will depend largely upon other factors than the chemical composition of the soil. The greatest loss from the use of improper mixtures of fertilisers was found to occur in acid soils.

We learn from the *Journal of Agriculture of South Australia* that the Irish potato blight (caused by the fungus *Phytophthora infestans*) has made its appearance in several of the Australian States. It does not appear that the disease is yet very widespread, and by mapping out the affected areas and adopting suitable precautions within those areas it should be possible to prevent great damage being done. A well-illustrated account of the disease is given, so that the practical man may readily recognise it, and methods of treatment are fully described. Spraying with Bordeaux mixture is a well-recognised preventive measure, and is discussed at some length.

A summary has recently been issued from the New Jersey Agricultural Experiment Station of the investigations carried out by Messrs. Voorhees and Lipman on various nitrogenous manures. Out of a hundred parts of nitrogen supplied as nitrate of soda, sixty-two parts were recovered in the crop over a period of ten years, and in the case of ammonium sulphate forty-three parts were recovered; these results agree almost exactly with those obtained by Wagner at Darmstadt. The relative availability of the various fertilisers tested was:—

Sodium nitrate	100
Ammonium sulphate	69·7
Dried blood	64·4
Solid manure (fresh)	35·9
Solid and liquid manure (fresh)	53·0
Solid and liquid manure (leached)	43·1
Solid manure (leached)	38·9

The fundamental importance of irrigation and of methods of dry-farming in South Africa is well brought out in a series of articles in recent issues of the *Agricultural Journal of the Cape of Good Hope*. Throughout considerable areas of South Africa the rainfall is either insufficient or is too irregularly distributed for the best crop returns to be obtained, and the chief problem in arable farming becomes the provision of proper water supply. Recourse may be had either to irrigation or to "dry farming," the former being more generally applicable than the latter. A delegate was sent to the National Irrigation Congress at Albuquerqu, New Mexico, U.S.A., and his report contains many suggestions likely to be of value in evolving methods suited to South Africa. There is also a report on the possibilities of irrigation in Bechuanaland. By way of encouraging dry farming, the De Beers Company is offering at the next Bloemfontein show a prize of 20*l.* for the best exhibit of maize grown on "dry lands" without irrigation.

In *Man* for November Mr. W. G. Aston raises the question of the origin of sexual antipathy among near relations.

Contesting the views of Messrs. Ellis and Crawley, he regards it as mainly based on a recognition by even savage tribes of the physical dangers of interbreeding. He lays stress on the dogma of Dr. Tylor that "exogamy was an early method of political self-preservation" in widening the influence of the clan by foreign alliances. Nothing is more fatal to a clan than consanguineous marriage, "and few things are more vital to the welfare of a family, a tribe, or a nation than the right ordering of the sexual relations."

IN the September number of *Spolia Zeylanica*, issued by the Colombo Museum, Ceylon, Mr. P. Arunachalam describes the ancient bronzes in the collection, and Mr. D. Wickremasimghe contributes notes on the inscriptions attached to them. The antiquity of the specimens is not very great. King Sigiri Kasypa rendered, we are told, "a lasting service to the chronological history of Ceylon by murdering his father in the fifth century A.D.; but for this signal act of parricide Ceylon dates would be in a greater state of confusion than they are," the date of this event separating the Mahawansa from the so-called Sulawansa period, which terminated in 1815 A.D. All the ancient bronzes in Ceylon belong to the period corresponding to the Middle Ages of Europe. The catalogue is well illustrated with photographs of the more notable specimens, and is of interest as facilitating the comparison of Sinhalese with Hindu art.

THE monthly review of cartography in *Petermann's Mitteilungen* (p. 281) contains articles by Dr. Max Gasser and Herr Moedebeck, president of the International Commission for "Luftschifferkarten," on maps for use on balloons and flying machines. The arrangement recommended is a general map on a scale of 1/1,000,000, with a smaller 1/200,000-map for the details of routes. The requirements of aërial navigation are dealt with in considerable detail, and a system of conventional signs and colours is proposed. It is suggested that the larger scale map should show parallels at intervals of ten minutes and meridians at intervals of twenty minutes, in accordance with the methods for astronomical determination of position worked out by Dr. Marcuses. Specimen maps accompany the papers.

IN *Symons's Meteorological Magazine* for November Dr. H. R. Mill gives a preliminary account of the remarkable rainfall of October 26–28 in the south of England. On the morning of October 26 the centre of a deep barometric depression lay to the south of Ireland, and moved slowly to the south-eastward; on October 28 a change of direction took place, the centre moving north-easterly, the effect being to enclose the south of England between the S.E. and N.E. paths of the depression. A list of the records is given for places where more than 2·5 inches of rain fell in one day, and more than 4 inches in three consecutive days. Both these conditions obtained in parts of Kent, Sussex, and the Isle of Wight. Among the heaviest falls during the three days, we note 6 inches at Ramsgate and 5·27 inches at Brighton; so far as available records show, no previous daily fall of 3 inches had been observed within twenty miles of Brighton, where 3·60 inches fell on October 26, or within forty miles of Broadstairs, where 3·14 inches fell on October 28. The month over the country as a whole was by no means so wet as October, 1903.

THE *Journal de Physique* for November contains a description of an electromagnetic compass suitable for use on board ironclads, which was described before the Société française de Physique more than a year ago by the inventor, M. Louis Dunoyer, and has now been tested on board one of the French cruisers. The apparatus consists of a solenoid wound with two wires in parallel, which can be rotated at a constant speed about a vertical axis to which its own axis is perpendicular. The ends of each of the two wires are connected to a two-part commutator on the axis of rotation, and the two pairs of brushes bearing on the commutators are set at right angles to each other. From the brushes wires lead to the coils of two moving coil galvanometers. The coils move about horizontal axes at right angles to each other, and mirrors attached to them produce images of two lines of light on a horizontal ground-glass screen. As the solenoid rotates the mean currents through the galvanometer coils are proportional to the sine and cosine of the angle between the axis of the ship and the horizontal component of the earth's magnetic field, and the line joining the crossing point of the two images to the centre of the screen gives the direction and magnitude of that component. The apparatus allows of ready compensation for both permanent and temporary magnetism of the ship. As the ship is "swung" the crossing point of the lines of light describes on the glass screen an ellipse, the axis major of which will, in general, be inclined to the direction of motion of both the galvanometer coils. By rotating the solenoid with respect to the commutators, the axis may be made to coincide with one of these directions. It is then only necessary to add resistance to the circuit of the coil which gives the larger deflection to reduce the ellipse to a circle, which would be the figure obtained if the earth's magnetic field were undisturbed by the vessel. The method is evidently very flexible, and admits of the observations being taken in the cabin while the rotating solenoid is placed on deck.

A PAPER on concrete pile foundations was read by Mr. Alex. Melville on November 23 before the Institution of Engineers and Shipbuilders in Scotland. Special reference was made to the Simplex method, a system which has been specified by the Admiralty for the naval base at Rosyth. This system is the invention of Mr. Frank Shuman, of Philadelphia, who took out his first patents in 1903. The essential principle lies in the driving of a tube or forme constructed of lap-welded steel, the lower end of which is closed by a loose point or by a pair of hinged jaws. These jaws open when the tube is being pulled up and permit concrete to be passed through, filling up the space left by the tube simultaneously with its withdrawal. The jaws are, as it were, cut out of a cylinder of exactly the same section as the sleeve, and so lie close against the sides of the hole left by the sleeve as the forme is withdrawn, thus offering no obstruction to the free passage of the concrete. A driving cap is attached to the top of the forme when the pile-driver is at work. On completion of driving the cap is removed, and concrete is filled into the forme to a height of several feet above the level of the finished head of the pile in order to allow for sinking as the forme is withdrawn, an operation performed by means of tackle connected to the pile-driver. Such piles can be inserted to any depth, and can be put in as close as 3 feet from centre to centre; reinforced piles on this system may also be executed. The method has many advantages, and has been very successfully applied in this and other countries.

Engineering for November 26 has an interesting leading article on the encouragement of aviation. Although there are some small signs of our waking up, everybody must deplore our backwardness in taking a lively and efficient interest in the new movement. It cannot be said, in regard to aviation, that public or national bodies have interfered with onerous legislation such as has retarded other budding industries. The movement has received but little encouragement in the way of State-aided experimental work; plenty of private pioneer work has been done—indeed, we were among the first to take seriously to aëronautics—yet we are woefully behind our neighbours. Extremely rapid progress has been made recently in other countries in heavier-than-air machines, and it seems clear that we should actively encourage the development of that branch of the science which appears of the greatest promise. Two methods have been adopted on the other side of the Atlantic which we might do worse than imitate. One is a national competition promoted by the United States War Department; the other is the method adopted by Dr. Graham Bell, who collected around him a number of ardent workers, who banded themselves together with the object of producing several successful machines. These men were all well acquainted with the principles underlying the art, and their collective wisdom has been well proven in the results achieved. Our own few earnest workers worry along independently, until financial stress often directs their attention to other matters. Continuing, our contemporary thinks that the movement of aviation is not in the right hands. Anyone who attends the meetings of the two best known societies connected with aëronautics must know that the discussions are not at all on a high level, and compare very unfavourably with those at, say, the Institution of Civil Engineers or the Institution of Mechanical Engineers. It is admitted that sport is quite a legitimate opening for aviation, as it has been for yachting and motoring; but, as has happened in these latter sports, the flying machines now built merely to win races will probably give place to machines of a more serviceable type when the movement has become leavened with the ideas of engineers and the results of scientific studies.

Evidence of the interest that is taken in the isomeric change of optically active compounds is afforded by two papers by Mr. H. Wren in the October number of the Chemical Society's Journal. The substance selected for examination was *l*-benzoin, $C_6H_5.CHOH.CO.C_6H_5$, a compound which contains an asymmetric carbon atom, but would lose its optical activity if converted into the isomeric "enol," $C_6H_5.C(OH):C(OH).C_6H_5$, and might therefore be expected to racemise with great readiness, at least in presence of an alkaline catalyst. The experiments carried out by the author showed that *l*-benzoin retained its activity in the crystalline state during three months, and that its solution in acetone was unchanged at the end of eight days. The addition of a small quantity of sodium ethoxide to its alcoholic solution was, however, sufficient to destroy its optical activity in a single day. The methyl ether, $C_6H_5.CH(OCH_3).CO.C_6H_5$, lost its optical activity completely in five minutes when dissolved in alcoholic potash of N/9 strength, and a progressive racemisation by dilute sodium ethoxide was completed in the course of three hours. Complete racemisation took place on attempting to prepare the ethyl ether by means of alcohol and hydrogen chloride, and a partial loss of activity took place when silver oxide and ethyl iodide were used. The oxime $C_6H_5.CH(OH).C(:NOH).C_6H_5$, and carbanilide

$$C_6H_5.CH(O.CO.NH.C_6H_5).CO.C_6H_5,$$

were found to be optically active, but the former suffered a partial loss of activity on acetylation, and the latter was completely racemised by heating above its melting point during four hours at 140°, contact with the glass being shown to be an important factor in promoting the change. A racemic product was also obtained on condensing *l*-benzoin with aniline. The changes here recorded are very similar to those that have been observed amongst the derivatives of camphor, but differ from them in that the inversion of the one asymmetric carbon atom causes a total loss of optical activity.

Dr. Maximilian Toch, of New York City, in his address as chairman of the American Society of Chemical Industry, dealt with the influence of chemistry on civilisation. The address is published in the issue of *Science* for November 19. In the course of his remarks, Dr. Toch said:—Chemistry needs no sponsor, but its effect on civilisation has been more marked than that of any other science. True, it has reached out and taken electricity and physics as aids, but, withal, engineering made but little progress until steel and cement—two chemical products—were cheapened, simplified, and made universal. Medicine has claimed great honours, but the masterful work done in coal-tar chemistry, in the production and discovery of synthetic drugs, the discovery of anæsthetics, the marvellous work done in the metabolism of matter, the excellent analytical schemes for the waste matter of the tissues, are all due to the researches of chemistry, and their civilising influence is greatly felt. The engineer may boast of his skill, but he has done nothing greater than the pyramids, nor finer than the temples of Greece and Egypt. The monuments he has wrought in steel were given to him by the ability of the chemist to control carbon in iron, and the economic principle involved in the production of steel supplies work, puts money into circulation, and keeps the wheels turning. For a science so young its civilising influence is enormous, and there is no doubt that the rapid progress which chemistry made in the nineteenth century will be outstripped in the twentieth, for the control of our foodstuffs, the application of the raw materials in the earth, and the refining of metals, create positions, give progress to a country, and help largely in the establishment of chemistry as a profession.

The Geological Society has published a catalogue of the geological literature added to the society's library during the year ended December 31, 1908. The catalogue has been compiled by the assistant-librarian and edited by the assistant-secretary, and its price is 2*s*.

Messrs. Flatters and Garnett, Ltd., 32 Dover Street, Manchester, have just issued a new classified catalogue of lantern-slides illustrating various subjects of biology, geology, astronomy, physiography, textile fibres, machinery, &c. The slides are from drawings, photographs of specimens, and photomicrographs, and most of them are not to be found in other catalogues. For the illustration of lectures or lessons in biological and other subjects many of the slides should prove very valuable.

OUR ASTRONOMICAL COLUMN.

Discovery of a New Comet, 1909*e*.—A telegram from the Kiel Centralstelle announces the discovery of a comet by Prof. Daniel, at Princeton, on December 6. Its position at 9h. 23·9m. (Princeton M.T.) was

$$R.A. = 6h.\ 16m.\ 32s.,\ dec. = 33°\ 50'\ N.,$$

and its magnitude was estimated as 11·0. This position lies at about the centre of the triangle formed by θ and κ Aurigæ and θ Geminorum. The comet is said to be moving slowly in a northerly direction.

Halley's Comet.—According to the ephemeris, Halley's comet is now approaching the sun at a rate of about 1,230,000 miles per day, whilst its distance from the earth is decreasing daily by some 460,000 miles; its distance from the earth on December 11, at 9 p.m., will be about 128·5 million miles.

Observations made at the Solar Physics Observatory, South Kensington, with the 36-inch reflector, show that the comet is a nebulous object, easily recognisable, and having no visible nucleus; exposures of five to ten minutes give a distinct image, and show how rapidly the object is moving in relation to the surrounding stars.

With a 3-inch Dallmeyer portrait lens, Mr. Longbottom, Chester, succeeded, on November 21, in photographing an excellent image of the comet, on an Ilford plate, in thirty minutes.

Absorption of Light in Space.—In this column for February 25 (vol. lxxix., p. 499) we directed attention to Prof. Kapteyn's researches on the absorption of light during its passage through interstellar space, in which he found a value corresponding to an absorption of 0·016 of a magnitude in a distance of thirty-three light-years.

Another paper dealing with this subject he now publishes in vol. xxx., No. 4, of the *Astrophysical Journal*, and as No. 42 of the "Contributions from the Mount Wilson Solar Observatory." The criterion he adopts is that such absorption would manifest itself, *ceteris paribus*, by the more distant stars being redder than the nearer ones. The subject is too complicated to discuss here, but, by comparing the photographic and visual magnitudes of stars of which the spectral types are known, from Misses Maury's and Cannon's classifications, and for which measures of distance are available, he succeeds in showing that such absorption probably does exist. The results indicate that for the photographic rays the loss per 32·6 light-years is 0·00945, while for the visual rays it is 0·00465, magnitude; the final value for *d* (increase in redness per 32·6 light-years) is 0·0066±0·0031 magnitude. Apparently there is no reason for assuming the absorption to be different in galactic and extra-galactic stars.

Incidentally, Prof. Kapteyn finds that for stars of the same spectral class, the ratio between the brightness of the violet radiations and that of the visual rays changes largely with the apparent magnitude. This, however, is probably a photographic, and not a cosmical, phenomenon.

Prof. Kapteyn's result proves abundantly that such large values, for the absorption, as are implied by the results recently brought out by certain investigators must be illusory.

Copernicus Anticipated.—No. 21 of the *Revue générale des Sciences* (November 15, p. 866) contains an interesting article, by M. Pierre Duhem, giving an account of the life and works of Nicole Oresme, who became Bishop of Lisieux in 1377, and died at that place in 1382. Oresme translated, with commentaries, the four books of Aristotle, but the translation was never printed, although there are several manuscript copies; it is on one of these that M. Duhem bases his note. In this work, Oresme, commenting on Aristotle's contentions for an unmovable, central earth, gives numerous reasons and arguments against such an hypothesis, and clearly shows that, in his opinion, it was entirely wrong. In concluding his note, M. Duhem suggests that, not only was Oresme the precursor of Copernicus, but he may have been, also, the inspirer.

Star Almanac and Calendar for 1910.—From Messrs. King, Sell and Olding we have received copies of "The Star Almanac for 1910," "The Star Calendar for 1910," and "The Stars from Year to Year." These works, for 1909, were reviewed in our columns for December 3, 1908, and maintain the favourable opinions then expressed concerning them. The prices are 3*d*., 1*s*., and 1*s*., respectively.

MAGNETIC EXPEDITIONS.

Of the many successfully conducted land expeditions sent out by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington since its establishment in 1904, news has just been received of the successful completion of two of the most important and interesting ones. Mr. D. C. Sowers headed an expedition which started out from Peking, China, on January 30 of this year, passing through China and Chinese Turkestan, reaching Kashgar on August 2, and then crossing the Himalayan range and arriving at Leh, India, at the end of September. Magnetic observations and other geographical data were obtained along the entire route traversed. Mr. Sowers's chief assistant was Prof. Fuson, formerly professor of history and geography at the Christian College, Fuson, China.

Mr. C. C. Stewart started out from Washington last July to take charge of a canoeing magnetic exploring expedition in British North America. After reaching Lake Abitibi the party next proceeded to Moose Factory, then crossed James Bay to Rupert House, then up the Rupert River, and coming out at Roberval, Lake St. John, the middle of October.

News has also been received of the successful progress of the land magnetic surveys in Africa under the charge of Profs. Beattie and Morrison, research associates of the Carnegie Institution, and of the magnetic work in charge of Mr. J. C. Pearson in Persia, Asia Minor, and southern Asiatic Russia.

With the resumption of the ocean magnetic work by the *Carnegie*, the director of the department, Dr. Bauer, estimates that at the present rate of progress it will be possible in another five years to construct accurate magnetic charts of declination, dip, and force, as based on freshly acquired data, for the region of the earth 60° N. to 60° S.

The department is also cooperating with polar expeditions so as to secure information in regions which cannot be entered by the *Carnegie*, this vessel not having been built for going into the ice. Thus instruments were loaned and instructions drawn up for Mr. Jackson, of the Canadian Meteorological Office, who was detailed for duty on the Canadian exploring steamer *Arctic* (formerly the *Gauss*), in command of Captain Bernier, the vessel having recently returned to Quebec. Mr. Jackson has informed Dr. Bauer that he has secured a series of magnetic, atmospheric electric, tidal and meteorological observations at various points in the Arctic regions.

So also Dr. C. C. Craft, magnetic observer of the department, was assigned to Commander Peary's auxiliary steamer, the *Eric*, a year ago, and obtained magnetic data at a number of points in Labrador, Baffin Land, and Greenland.

During the past summer Mr. E. Kidson, formerly assistant at the Christchurch Magnetic Observatory, completed a magnetic survey of the interior of Newfoundland, and in the early part of the year an expedition, in charge of Mr. C. Sligh, made magnetic observations along the coasts and in the interior of Central America.

ETHNOGRAPHY IN THE PHILIPPINE ISLANDS.

The Government Bureau of Science of the Philippine Islands is actively prosecuting inquiries into the physical anthropology and ethnography of the archipelago. The fourth part of the fourth volume of its Proceedings contains two papers of more than ordinary importance.

Mr. R. B. Bean contributes an elaborate article on the littoral population of Luzon and the adjacent islands, based on measurements of students at Manila. The view generally accepted is that of M. L. J. Montano ("Rapport a M. le Ministre de l'Instruction publique sur une Mission aux Îles Philippines et en Malaisie," Paris, 1879–81), who classes the inhabitants of the mountainous regions of the interior as Negritos; those of the fertile parts of the interior as Indonesian; those of the coast lands as Malay. In addition to these there is a considerable Spanish element, and, since the last conquest of the archipelago, American and negro mestizos or half-castes are springing up in every part of the islands, thus presenting in a very mixed population a series of most interesting problems for the physical anthropologist. Mr. Bean, from his recent inquiries, classifies the coast population into Modified Iberian, Australoid, and Primitive, with several intermediate types. The Modified Iberians correspond to the Mediterranean race of Sergi; the Australoids are below the medium height, with narrow heads, broad noses and faces; the Primitives resemble the latter, but have a cephalic index ten in excess of the Iberian. The Australoid and Primitive types are probably the original elements in the population, the other types representing modifications caused by the introduction of Europeans and Chinese, recent and remote. The result is an improvement in all the physical measurements, which, with increasing European and Chinese immigration, will probably advance, and be accompanied by an increase of bodily and mental vigour, a process facilitated by improved nutrition and in hygiene by the reduction of noxious parasitic life.

The second paper devoted to pure ethnography is an account, by Fr. Juan Villaverde, of the Quiangan Ifugao tribes. They are of Negrito affinities, and present a remarkable combination of an advanced culture with savagery. They live by agriculture, cultivating rice in the hilly tracts by an elaborate system of terrace farming, by which they utilise the supplies of spring water which they consider necessary to the growth of this crop. They have neither king nor rulers, but are divided into two distinct grades, the nobles exercising considerable authority over the plebeians. A man can rise to the higher from the lower class by the exercise of profuse hospitality, which is provided by a series of elaborate feasts. They respect the aged, who act the part of priests in their idolatrous rites, and generally hold women in high estimation. They divorce their wives continually, each of the pair readily finding a fresh partner. Their worship is chiefly that of the moon and other heavenly bodies, and they practise divination to relieve the fears of the spirit world which always beset them. They lend and borrow on exorbitant interest, and sons are responsible for the debts of their parents. Combined with this fairly advanced culture they are grossly addicted to drunkenness, and the absence of any controlling authority leads to constant blood feuds, every murder being followed by inexorable vengeance extending, not only to the offender, but embracing his nearest relatives. This is accompanied by the custom of head-hunting, in which even women, though ordinarily respected, and children are not spared, the heads of the victims being brought home in triumph, and the fronts of the houses decorated with the captured heads.

Ifugaos with wooden shovels, Banaue.

THE DEVELOPMENT OF EVOLUTIONARY IDEAS.

THE annual Herbert Spencer lecture was delivered at Oxford on December 2 by the Linacre professor, Dr. G. C. Bourne. In the course of a brief historical sketch, the lecturer pointed out that evolutionary ideas were widely prevalent at the end of the eighteenth century, though, after being apparently routed by Cuvier, the doctrine remained for many years in abeyance. Herbert Spencer was a pioneer in the evolutionary revival. Not an original investigator in zoology or botany, he was yet a very earnest student of biological subjects. Evolution, in Spencer's view, was a cosmic process, consisting essentially in the passage of the homogeneous into the heterogeneous. Confronted with the difficulty of the transition from the non-living to the living, Spencer framed the theory of "physiological units" with their mutual interactions. This proved to be a fertile idea, and was adopted in one form or another by many subsequent investigators. In phylogeny there is a real advance from the homogeneous to the heterogeneous; in ontogeny, however, there are obvious difficulties in the way of this interpretation. These difficulties Herbert Spencer tried to meet by assuming for his units "polarities" of differing values, and a power of undergoing modification when subject to the influence of each other and of the environment. Hence a true epigenesis took place, and in this way he thought it possible to account for both inheritance and variation. Acquired characters, he held, *must* be inherited; and on this basis he reared the fabric of the "synthetic philosophy."

Against the system thus outlined, two crushing blows were delivered by Weismann. The first was his insistence on the fact that there is no clear evidence of the inheritance of acquired characters; the second was the demonstration that the germ-plasm in ontogeny is from the first a structure of very great complexity. The germ, it was found, must have historical properties, and the embryological history of the individual is really a genealogy.

The bearing of recent experiments in the "mechanics of development" upon the views of Spencer and Weismann respectively was very carefully and lucidly explained by Prof. Bourne, who showed that the pre-existence of certain materials in the germ, and their subsequent sorting out in the course of ontogeny, facts which could no longer be denied, were entirely adverse to the Spencerian conception. On the other hand, the view of Weismann, though in some particulars erroneous, received in the main a strong confirmation from experiments by the followers of Mendel. Prof. Bourne concluded his discourse by urging that biological studies were no mere plaything, but of the highest importance for dealing with human affairs. An essential link was now broken in the chain of the synthetic philosophy, and it behoved those concerned in such matters to inquire whether our sociological methods were right, and whether certain schemes of social improvement, founded on the biological principles of fifty years ago, should not be re-considered in the light of those of the present day.

RESEARCHES IN RADIO-TELEGRAPHY.[1]

II.

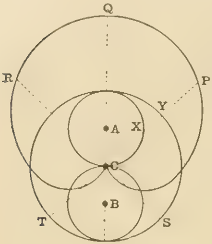

Fig. 13.

In a previous discourse explanations were given of the property of a closed or partly closed antenna of radiating more in some directions than others, and the action of Marconi's bent antenna was described. Two other inventors, Messrs. Bellini and Tosi, have taken advantage of this fact to construct antennæ of a very interesting character. They erect an antenna consisting of two wires, each bent into a triangular form, the top ends nearly meeting, the planes of these triangles being at right angles to one another, and both of them vertical. The nearly closed antenna circuits are then inductively coupled with a condenser circuit, which is capable of being swivelled round in various directions. If the said condenser circuit is placed in such a position as to be coupled with one of the triangular antennæ it will cause the maximum radiation to take place in the plane of that antenna, but none at all at right angles to it. If it is coupled with the other antenna it will cause radiation to take place to a maximum degree in the plane of that second antenna. If, however, the oscillatory circuit is placed in an intermediate position, so as to act inductively upon both the nearly closed triangular antennæ, then it can be shown, both mathematically and experimentally, that the radiation of the combined system is a maximum in the direction of the plane of the oscillatory circuit which is coupled with the antenna. Hence, with such a combined antenna, we have it in our power to create radiation most strongly in one direction, although not entirely suppressed in all other directions. By combining together, however, a single vertical antenna with two nearly closed circuit antennæ at right angles to one another, Messrs. Bellini and Tosi have constructed a complex antenna which has the property of producing radiation almost entirely limited to one-half the circumjacent space (Fig. 13). It therefore corresponds to a certain extent in effect to the optical apparatus of a lighthouse, with catoptric or dioptric apparatus, which projects the light from the lamp largely in one direction. It is not yet possible to make with electric radiation of long wave-length that which corresponds precisely with a beam of light wholly concentrated along a certain cone or cylinder, but it is possible, by the use of a complex antenna as described, greatly to limit the diffusion of the radiation. Since radiating and absorbing power go hand in hand, it is obvious that such a directive antenna also enables the position of a sending station to be located. Messrs. Bellini and Tosi have accordingly applied their methods in the construction of a *radiogoniometer* and receiving antenna, by means of which they can locate the direction of the sending station without moving the antenna, but merely by turning round a secondary circuit into a position in which the maximum sound is heard in a telephone connected with the receiver. By the kindness of Captain Tosi I am able to exhibit to you their ingenious apparatus (Fig. 14).

The space occupied by such closed antennæ has hitherto prevented their employment on ships. There is still, therefore, an opening for the invention of apparatus capable of being used on board ship which will enable one ship to locate, within narrow limits, the direction of another ship sending signals to it, and therefore of ascertaining immediately the direction from which some call for help is proceeding.

We must pass on to notice, in the next place, some improvements in oscillation detectors and means of testing them. As already explained, the æther waves sent out by the transmitting antenna fall on the receiving antenna and create in it, or some other circuit connected to it, very feeble oscillations. These oscillations being very feeble, alternating currents of high frequency cannot directly affect either an ordinary telegraphic instrument or a telephone, but we have to interpose a device of some kind called an oscillation detector, which is affected by oscillations in such a manner that it undergoes some change, which in turn enables it to create, increase, or diminish a local current produced by a local battery, and so affect a telephone or telegraphic relay. One kind of change the oscillations can produce in certain devices is a change in their electric resistance, which in turn is caused to increase or diminish a current through a telephone or telegraphic relay generated by a local battery. To this type belong the well-known coherers of Branly, Lodge, and Marconi, which require tapping or rotating to bring them back continually to a condition of sensitiveness.

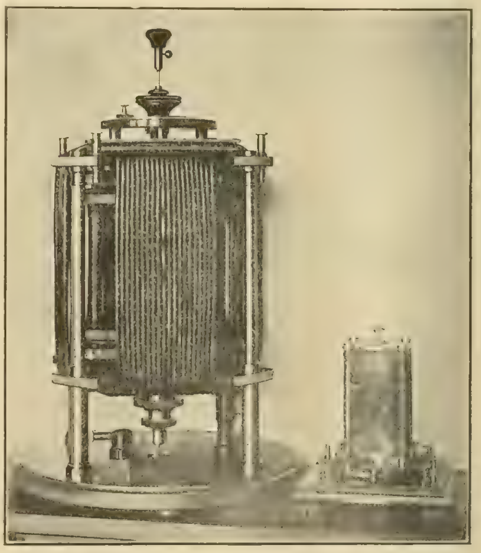

Fig. 14.—Bellini and Tosi's Radiogoniometers for Directive Radiotelegraphy.

Coherers, however, have been devised which require no tapping. Thus it has been found by Mr. L. H. Walter that if a short length of very fine tantalum wire is dipped into mercury there is a very imperfect contact between the mercury and tantalum for low electromotive forces. This may perhaps arise from the fact that tantalum, like iron, is not wetted by mercury. If, however, feeble electric oscillations act between the mercury and tantalum, the contact is improved whilst they last. If, then, the terminals of a circuit containing a telephone in series with a shunted voltaic cell are connected to the mercury and tantalum respectively, and if damped or intermittent trains of electric waves fall on an antenna and excite oscillations which are allowed to act on the mercury-tantalum junction, then at each train the resistance of the contact falls, the local cell sends current through the telephone and produces a short sound, and if the trains come frequently enough this sound is repeated and will be heard as a continuous noise in the telephone (Fig. 15). This sound can be cut up into dot and dash signals by a key in the sending instrument. If the transmitter is sending persistent oscillations, then some form of interrupter has to be inserted in the receiving circuit to enable us to receive a continuous sound in the telephone, which can be resolved into Morse dot and dash signals by the key in the transmitter. The operator usually wears on his head a double telephone, and listens to these long and short sounds in the telephone, and writes down each letter or word as he hears it.

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[1] From a discourse delivered at the Royal Institution, on Friday, June 4 By Prof. J. A. Fleming, F.R.S. Continued from p. 144.

The reception of signals in modern radio-telegraphy is most usually effected by ear by means of some type of oscillation detector capable of actuating a telephone. It is important, then, to notice that, to obtain the highest sensitiveness when using the telephonic method of reception, the spark frequency or number of oscillation trains or the number of interruptions of the persistent train per second must take place at such a rate that it agrees with the natural time period of the diaphragm of the telephone used. An ordinary telephone receiver is most sensitive, according to the researches of Lord Rayleigh and M. Wien, for some frequency lying between 500 and 1000. Thus Lord Rayleigh (see *Phil. Mag.*, vol. xxxviii., 1894, p. 285) measured the alternating current in microamperes required to produce the least audible sound in a telephone receiver of 70 ohms resistance at various frequencies, and found values as follows:—

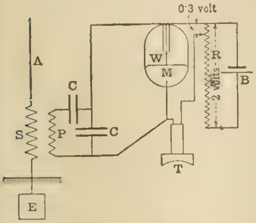

FIG. 15.—Walter's Tantalum Detector.

TABLE II.

Frequency...	128	192	256	307	320	384	512	640	768
Least audible current in microamperes	28	2·5	0·83	0·49	0·32	0·15	0·07	0·04	0·1

M. Wien found for a Siemens telephone somewhat different results, viz.:—

Frequency...	64	128	256	512	720	1927	1500
Least audible current in microamperes ...	12	1·5	0·13	0·027	0·008	0·013	0·024

Both, however, agree in showing a maximum sensitiveness for currents of a frequency between 600 and 700. This is due to the fact that the frequency of the actuating current then agrees with the natural frequency of the ordinary telephone diaphragm. Hence alternators for large-power radio-telegraphic stations are now designed to give currents with a frequency of about 300 or 600 alternations per second, so that, when producing discharges of a condenser, the number of sparks per second may be at least 600, and fulfil the conditions for giving maximum sound in the telephone of the receiver per microampere.

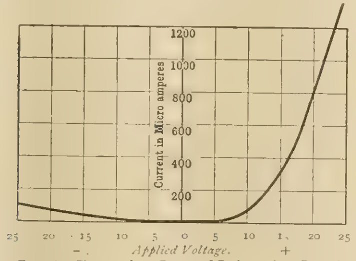

FIG. 16.—Characteristic Curves of Carborundum Crystal.

Another class of oscillation detector recently discovered comprises the crystal detectors, which depend on the possession by certain crystals of the curious property of acting as an electrical valve, or having greater conductivity in one direction than the other, and also on not obeying Ohm's law as conductors. It was discovered by General Dunwoody, of the United States Army, in 1906, that a mass of carborundum, which is a crystalline carbide of silicon formed in electric furnaces, can act as a detector of electric oscillations if inserted in the circuit of an antenna, the crystal mass being held strongly pressed between two spring clips, which are also connected by a shunted voltaic cell in series with a telephone. When feeble oscillations are set up in the antenna, a sound is heard in the telephone.

This property of carborundum has been carefully investigated by Prof. G. W. Pierce, of Harvard, and he showed that a single crystal of carborundum has remarkable unilateral conductivity for certain voltages when held with a certain contact pressure between metallic clips. Thus for a crystal held with a pressure of 1 kilogram, and subjected to an electromotive force of 30 volts, the conductivity in one direction through the crystal was 4000 greater than in the opposite direction (Fig. 16). The result of these experiments was also to show that the current voltage curve or characteristic curve of a carborundum crystal is not linear—that is to say, the crystal, as a conductor, does not comply with Ohm's law, for the resistance of the crystal decreases as the current is increased. Hence the conductivity of the crystal is a function of the voltage acting on it (Fig. 17). Accordingly, if we pass a current from a local cell through a crystal under a voltage, say, of 2 volts, a telephone being inserted in series with the cell, and if we apply an oscillatory voltage also to the crystal, which varies, say, between +0·5 and −0·5 volt, then the crystal is alternately subjected to a voltage of 2·5 and 1·5 volts, but the corresponding currents would be, say, 8·4 and 1·8 microamperes, as shown by an experiment with one particular crystal employed by Prof. Pierce. The mean current would then be 5·1 microamperes, whereas the steady voltage of 2 volts would only pass a current of 4 microamperes. Hence, apart from the unilateral conductivity, and merely in virtue of the fact that the characteristic curve is not a straight line, we find that such a crystal, or even a confused mass of crystals, can act as a radio-telegraphic detector.

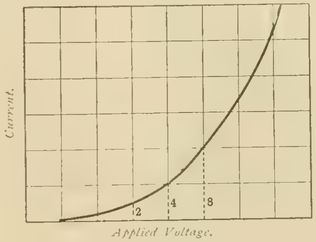

FIG. 17.

There are, therefore, two ways in which a crystalline mass of carborundum can be used as a radio-telegraphic detector. It consists of a conglomeration of crystals arranged in a disorderly manner, or not so symmetrically as to neutralise one another's unilateral conductivity. Hence the mass of crystals, like the single crystal, possesses unilateral conductivity, and also a conductivity which is a function of the voltage applied to it. We may then use it without a local cell, and avail ourselves of its valve property to rectify the trains of oscillations in the antenna and convert them into short unidirectional trains which can affect a galvanometer or telephone; or, secondly, we may place the crystal between the ends of a circuit containing a telephone and a shunted voltaic cell, and then on passing oscillations through the crystal we hear sounds in the telephone, due to the fact that the conductivity is a function of the voltage, and is therefore increased more by the addition than it is diminished by the subtraction of the electromotive force of the oscillations to or from the steady voltage of the local cell. The telephone, therefore, detects this change in the average value of the current by a sound emitted by it. Prof. Pierce has discovered that several other crystals possess similar properties to carborundum—for example, hessite, which is a native crystalline telluride of silver or gold; an anatase, which is an oxide of titanium; and molybdenite, which is a sulphide of molybdenum. As regards the origin of this curious unilateral conductivity, it seems clear that it is not thermoelectric, but at present no entirely satisfactory theory of the action has been suggested.

A number of forms of oscillation detector have recently been invented which depend on the curious fact that a slight contact between certain classes of conductors possesses a unilateral conductivity, and can therefore rectify oscillations. One such detector, now much used in Germany, consists of a plumbago or graphite point pressed lightly against a surface of galena. It has been found by Otto von Bronk that a galena-tellurium contact is even more effective. To the same class belongs the silicon-steel detector of Pickard. If such a contact is inserted across the terminals of a condenser placed in the receiving circuit, and if it is also in series with a telephone, the trains of oscillations are rectified or converted into more or less prolonged gushes of electricity in one direction through the telephone. These, coming at a frequency of several hundred per second, corresponding to the spark frequency, create a sound in the telephone, which can be cut up by the sending key into Morse signals. According to the researches of Prof. Pierce and Mr. Austin, it seems clear in many cases that this rectifying action is not thermoelectric, since the rectified current is in the opposite direction to the current obtained by heating the junction.

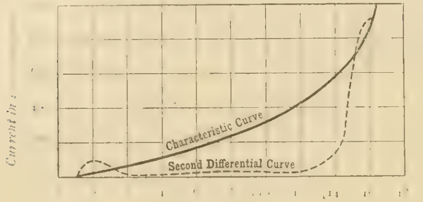

FIG. 18.—Characteristic Curve of Rarefied Gas Ionised by Hot Negative Electrode.

I may, then, bring to your notice some recent work on another form of radio-telegraphic detector, which I first described to the Royal Society about five years ago under the name of oscillation valve. It consists of an electric glow-lamp, in the bulb of which is placed a cylinder of metal, which surrounds the filament but does not touch it. This cylinder is connected to a wire sealed through the glass. Instead of a cylinder, one or more metal plates are sometimes used. The filament may be carbon or a metallic filament, and I found some year or more ago that tungsten in various forms has special advantages. The bulb is exhausted to a high vacuum, but, of course, this means it includes highly rarefied gas of some kind. When the filament is rendered incandescent it emits electrons, and these electrons or negative ions give to the residual gas a unilateral conductivity, as shown by me in a Friday evening lecture given here nineteen years ago. Moreover, the ionised gas not only possesses unilateral conductivity, but its conductivity, like that of the crystals just mentioned, is a function of the voltage applied to it. Hence, if we apply an electromotive force between the hot filament and the cool metal plate, we find that negative electricity can pass from the filament to the plate through the ionised gas, and that the relation between the current and voltage is not linear, but is represented by a characteristic curve bending upwards, which has changes of curvature in it (Fig. 18). The sharp bend upwards at one place implies a large increase in the current corresponding to a certain voltage, which means that, corresponding to a certain potential gradient, and therefore velocity of the electrons, considerable ionisation of the residual gas is beginning to take place. The current, however, would not increase indefinitely with the voltage, but would before long become constant or saturated.

It will be seen, therefore, that at points on the curve where there is a bend or change of curvature, the second differential coefficient of the curve may have a large value. Hence, if we consider the current and voltage corresponding to this point, it will be seen that any small increase in the voltage increases the current more than an equal small decrease in voltage diminishes it. If, then, we superimpose on a steady voltage corresponding to a point of inflexion of the curve an alternating voltage, the average value of the current will be increased. This, then, points out two ways in which this oscillation valve or glow-lamp can be used as a radio-telegraphic detector. First, we may make use of the unilateral conductivity of the ionised gas in the bulb and employ the glow-lamp with cylinder around the incandescent filament, as a rectifier of trains of oscillations to make them effect a galvanometer or telephone. This method was described by me in papers and specifications in 1904 and 1905. In that case the valve is arranged in connection with a receiving antenna, as shown in Fig. 19, and used with a galvanometer or telephone. Mr. Marconi subsequently added an induction coil and condenser, and employed in 1907 the arrangements shown in Fig. 20. In this case the trains of oscillations set up in the antenna could not by themselves affect a galvanometer or a telephone, but, when rectified by the valve, they become equivalent to an intermittent unidirectional current, and can then affect the telephone or a galvanometer, or any instrument for detecting a direct current.

On the other hand, we may take advantage, as I have more recently shown, of the non-linear form of the characteristic curve. In other words, of the fact that the conductivity of the ionised gas is a function of the voltage applied to it, and in the second method the valve and receiving circuits are arranged as shown in Fig. 21. In this case we have to apply to the ionised gas a unidirectional electromotive force which corresponds to a point of inflexion on the characteristic curve, and then to add to this voltage the alternating voltage of the oscillations set up by the incident electric waves in the receiving circuit. The result is to cause a change in the average value of the current through the telephone, and therefore to produce a sound in it, long or short, according to the number of trains of waves falling on the antenna. This last method, then, requires the application in the telephone circuit of an accurately adjusted steady electromotive force, not any electromotive force, but just that value which corresponds to a point on the characteristic curve at which there is a sudden change of curvature.

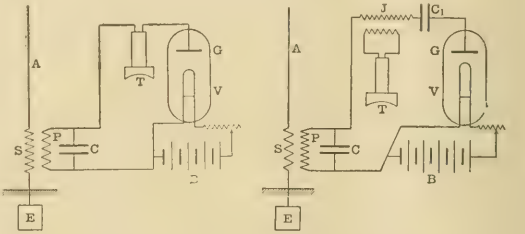

FIG. 19. FIG. 20.

Connections for Oscillation Valve used as Radiotelegraphic Detector.

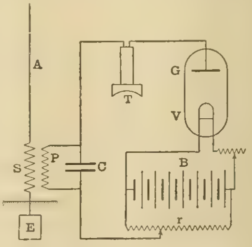

FIG. 21.—Connections for Oscillation Valve used as a Radiotelegraphic Detector.

At this point we may notice a broad generalisation which has already been made by H. Brandes, viz. that any materials such as the crystals mentioned, or ionised gases, which do not obey Ohm's law as regards the independence of conductivity on impressed voltage can be used as radio-telegraphic receivers. It is necessary to be able to test the relative sensibility of detectors to know whether any new form is an improvement. It is not always possible for an inventor to get these tests made at real wireless telegraph stations. Moreover, it is no use to test over short distances, because then all detectors appear to be equally good. I have found, however, that we can make these comparative tests very easily within quite moderate distances by employing closed sending and receiving circuits which are poor radiators. All the devices called wave detectors are really only oscillation detectors, and we can therefore test their value simply by ascertaining how feeble an alternating current or alternating voltage they will detect. If we, then, set up in one place a square circuit of wire a few feet inside, and complete the circuit by a condenser and a spark-gap, we can set up oscillations in it by means of an induction coil. I find that it is necessary to enclose the spark-gap in a cast-iron box, and to blow upon the spark with a jet of air to secure silence, absence of emission of electromagnetic waves direct from the spark balls, and constancy in the oscillatory circuit. I then set up, a few score or few hundred feet away, a similar tuned closed oscillatory circuit, and I connect the oscillation detector to be tested either in this circuit or as a shunt across the condenser. The closed receiving circuit is so constructed that it may be rotated round either of three axes. It is then generally possible to find some position of the receiving circuit such that no sounds are heard in a telephone connected to a highly sensitive detector associated with the circuit. This position is called the zero position. If the receiving circuit is rotated round some axis, it begins at a certain displacement to receive signals, and the angle through which it has to be turned is a measure of the insensibility of the particular oscillation detector being used. I find, for instance, that it is quite easy to take one of my oscillation valves, a magnetic detector, an electrolytic detector, a crystal detector, or any other type, and arrange these in order of their sensibility by means of the device described.

Sensibility is not, however, the only virtue which a wave detector should possess. It is important that it should be simple, easily adjusted, and not injured by the chance passage through it of any unusually large oscillatory currents. Another quality which is desirable is that it should be quantitative in its action, and that any change in the amplitude of the wave received should be accompanied by an equal change in the current which the detector allows to pass through the telephone. A quantitative oscillation detector, then, enables not merely signals, but audible speech to be transmitted. In other words, it can effect wireless telephony. The difficulties, however, in connection with the achievement of wireless telephony are not so much in the receiver as in the transmitter. We have to obtain, first, the uniform production of persistent electromagnetic waves radiated from an antenna, and next we have to vary the amplitude of these electric waves proportionately to, and by means of, the aërial vibrations created by the voice speaking to some form of microphone. We cannot employ an intermittent spark generator, because each spark would give rise to a sound in the telephone, and these sounds, if occurring at regular intervals, would produce a musical note in the telephone. If, however, we make the sparks run together into what is practically a high-voltage arc taking a small current, then, in an oscillatory circuit shunted across this arc, we have set up persistent high-frequency oscillations, as first achieved by Mr. Duddell.

We can greatly increase the energy of the oscillations by immersing the arc in a strong transverse magnetic field and also in a hydrocarbon gas, as shown by Poulsen, or we may employ a number of arcs in series. E. Ruhmer has lately also employed a high-tension arc between aluminium electrodes (Fig. 22), shunted by a condenser and inductance as a means of generating persistent oscillations. As an alternative, it is possible to create them by a mechanical method, viz. by a high-frequency alternator, subject, however, to certain limitations as to frequency. Both these types of generator have their advantages and practical objections. There is good evidence that radio-telephony has been accomplished over distances of 100 miles or more by each of these methods in the hands of experts, but what is now required is the reduction of the apparatus to such simple manageable and practical form that it can be applied in regular work. The wave-generating apparatus must be capable of producing uniform persistent oscillations of high voltage and frequency, not less than 30,000 or 40,000 per second, or at least above the limits of audition, and the amplitude of these oscillations must be capable of being varied by some form of speaking microphone placed in the oscillation circuit or in the radiating antenna, or in a secondary circuit coupled to it. No ordinary simple carbon microphone will safely pass sufficient current for this purpose. A type of multiple microphone has been used successfully, and also a duplex microphone, the invention of Ernst Ruhmer.

It is not, however, possible to speak of radio-telephony at the present time as having reached the same level of practical perfection as radio-telegraphy; but the possibilities of it are of such a nature that it will continue to attract the serious attention of inventors. This is not the place to enter into a full discussion of the causes which limit submarine telephony through cables, but there are well-known reasons in the nature of submarine cables as at present made which impose very definite limits upon it, owing to what is called distortion of the wave form. Electric wave telephony is free at least from this disadvantage, and if (as has been asserted) arc generators can be made self-regulating and capable of being worked for hours automatically, or even for ten minutes without being touched, then the remaining difficulties with the microphone are not insuperable.

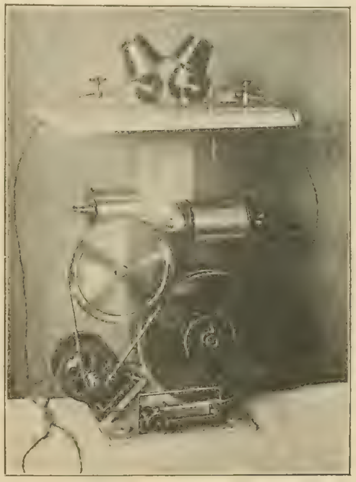

FIG. 22.—Ernst Ruhmer's High-tension Aluminium Arc for producing persistent Oscillations for Radiotelephony.

Time does not permit of the discussion of the many other points in connection with radio-telegraphy and telephony which have been the subject of recent work. Much attention has been paid lately to methods of cutting out atmospheric signals due to natural electrical discharges in the atmosphere, which are troublesome disturbers of the ætherial calm necessary for radio-telegraphy. Considerable thought and expenditure have been necessary to discover means for overcoming the difficulties of long-distance transmission by daylight, and also those arising from the cross-talk of other stations. Much also has been done in training skilled wireless operators both in the Navy and for the mercantile marine work. Radio-telegraphy, like aviation, is an art as well as a science, hence personal skill is a factor of importance in turning the flank of the difficulties of the moment. Nevertheless, the art and the science of radio-telegraphy are both progressing, and the splendid services already rendered by it in saving life at sea are at once a proof of present perfection and an evidence that the arduous labours of investigators and inventors have borne fruit in yet larger powers to command the great forces of nature for the use and benefit of mankind.

ILLUMINATING ENGINEERING.[1]

THIS society has been founded to bring together all those who are interested in the problems, practical and theoretical, of the *art of directing and adapting light, that prime necessity of* civilised, as well as of uncivilised, *existence, to the use and convenience of man.* To advance the subject of illuminating engineering, to investigate through all its lengthened breadth the facts within its domain, to increase and diffuse knowledge respecting them, and to unite those who are devoting their energies to these things, is the object of the society. The ascertained facts are few—all too few; their significance is immense; their economic and social value is great; but the ignorance respecting them generally is colossal.

For practically a century only have there been any systematic means of illumination in use in any civilised country. Before the year 1800 there were as means of illumination daylight, oil lamps, rush lights, tallow dips, and wax candles. Monarch and peasant, merchant-prince and workman, had alike to depend on individual sources of light at night. Only in the larger towns and cities was there any organised attempt to light the streets by oil lamps. In 1819 the authorities of the day stoutly resisted the proposal to light the then House of Commons by gas—nothing but wax candles could be admitted; but gas lighting was coming in, and Argand and colza oil lamps were the sole competitors until after 1850. Everything else dates since then—practically during the last half-century. For paraffin lamps were not widely spread until the 'sixties. Arc lighting, though tried for spectacular and lighthouse purposes from the 'fifties, did not come into public question until about 1879. Glow-lamps followed three or four years later. Still later came incandescent gas mantles and acetylene gas lights, while the newest things in both gas lighting and electric lighting are affairs of only a year or two ago. Many persons now realise the immense stride made in the introduction of the Auer (Welsbach) mantle for incandescent gas; very many fewer people realise the significance of the corresponding step forward that has been begun by the introduction of the metallic filament glow-lamp. We are on both sides in the very middle of an immense evolution in the art of illumination.

But whilst the means of illumination have thus been developing with amazing strides during a single generation, and the organised systems of distribution by municipal and urban and rural authorities, and by private corporations, have ramified throughout the community and brought supplies of gas and of electricity—shall I also say of oil?—to our doors, there has been another and very different development going on. I refer to the growth of that branch of the science of optics which deals with the measurement of luminous values. Photometry has been growing into an exact science by the explanation of its laws and the improvement of the instruments of measurement. It was not until 1760 that the first real discussion of photometric principles was made known. In that year Lambert, in his "Photometria," laid down the fundamental laws, and likewise in the same year Bonguer gave to the world his "Traité d'Optique," wherein a primitive photometer was described. Rumford's shadow photometer was invented in 1794, and Ritchie's in 1824. Then comes a long gap. Save for Bunsen's over-rated grease-spot instrument, there was no important advance in photometry until the 'eighties, when there were produced many novel forms, some of them, including the now well-known forms of L. Weber, Lummer-Brodhun, and Rood, capable of yielding results of much higher precision in the comparison of different sources of light; also in the 'eighties we meet for the first time with special forms of photometer of the kind destined to play a very important part in the work of our society, many photometers measuring the values, not of the brilliancy of a source of light, but the illumination of a surface.

Our primary concern is the adequate and proper illumination of things; and as we have to reduce the present chaos to an exact science, our first business is to secure some common agreement as to the measurement of illumination and the establishment of reasonable rules as to the amounts of illumination required in different cases.

Foremost, then, in the programme of work for our society we put the question of the units of measurements and the promulgation of the proper definitions of them. We must secure agreement—national and, if possible, international—as to what shall be taken as the unit of light and what as the unit of illumination at a surface.

Happily, the long-standing controversy as to the former appears to be settling itself by at least a preliminary agreement between the standardising laboratories of the great nations. One "candle" is no longer to be a vague and indefinite thing. The new definition provisionally agreed upon is an ideal unit, in terms of which one can describe the several standards in use in different countries. If this provisional *entente* can but be ratified by a little international common sense, we shall have henceforward an international "candle" such that it is the same in England as in America, equal to the *bougie décimale* accepted in France, and related to the Hefner-candle of Germany in the precise proportion of ten to nine.

But we have still to find agreement on the standard of illumination. Here in England, and in the United States, we have already grown accustomed to describe amounts of illumination of surfaces in terms of a British unit—the "candle-foot"—not perhaps a very happy term—one that we would readily exchange for a better—meaning, thereby, the intensity of the illumination at a surface situated at the distance of one foot from a light of one "candle." The source being assumed here to be concentrated at a point, the law of inverse squares holds good.

Adopting the candle-foot as the unit of illumination, one may readily state certain facts with definiteness. All competent authorities are agreed that at night, for the purpose of reading, an illumination is required not less than one candle-foot, some authorities saying $1\frac{1}{2}$ candle-foot. The facts appear to be that reading is impossible with an illumination of one-tenth candle-foot, difficult and fatiguing with one of one-fifth candle-foot, comfortable with from $1\frac{1}{2}$ to 3 or 4 candle-foot, but that if the illumination exceeds 6 or 8 candle-foot, the glare of the page is again fatiguing and dazzling. The page should neither be under-illuminated nor over-illuminated. Something depends, it is true, on the size of the print. Under a feeble illumination of, say, $\frac{1}{2}$ candle-foot, a type of pica size printed in a fount of bold face properly inked is legible when one of long-primer size, printed in a weak way, would be practically illegible. Something also depends on the state of the eye as affected by the general illumination of the surroundings. Very seldom does one find in any ordinary room an artificial illumination exceeding 3 candle-foot. By day, on a writing-table placed near a north window—or near any window not receiving direct sunlight—the illumination may exceed 3, and may even attain 4 or 5 candle-foot.

Until a unit of illumination was thus agreed upon, it was impossible to render any reasonable certainty to estimates of the amount of illumination in any case of dispute. What is the meaning of the term well-lit as applied to any room, building, factory, workshop, or school? Formerly the term was entirely vague. To-day the answer can be given in numerical terms. Formerly judgment had to be made by the unaided eye, and the eye is notoriously a bad judge. As between two different illuminations, the powers of discrimination of the eye are very limited. The eye can equate, but it cannot appraise. It can tell with fair accuracy whether two adjacent patches are equally bright; if they are not equally bright it cannot say with any kind of proportionality what their relative brightnesses are. All photometry depends on the perception of an equality.

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[1] Abridged from the inaugural address delivered at the inaugural meeting of the Illuminating Engineering Society held on November 18, by Prof. Silvanus P. Thompson, F.R.S., president of the society.

Photometers for the measurement of illumination have been mentioned earlier as coming first into notice in the 'eighties. One of the earliest in this country was that constructed by Sir William Preece, with the assistance of Mr. A. P. Trotter, for measurement of the illumination of side-walks and pavements of streets. It has been subsequently developed by Mr. Trotter, and as constructed by Mr. Edgcombe is a most useful and handy instrument, telling the amount of illumination directly in terms of the candle-foot. Another, by Mr. Haydn Harrison, measures the illumination, not on the horizontal, but at 45°. Almost equally early with the Preece-Trotter illumination photometer was the school photometer of Petruschewsky, apparently little known in this country. Most recent of this sort is the form due to Martens.

The principles and construction of photometers are matters that have interested me for nearly thirty years. About 1880 I brought out a form of wedge-photometer (modified from Ritchie's form), in conjunction with Mr. C. C. Starling, for electric light measurements. Later I gave to the Physical Society an investigation of the errors arising in photometry from the almost universal assumption that the law of inverse squares is fulfilled. In 1882, when lecturing at the Crystal Palace Exhibition, I gave diagrams to show the effect of the superposition of illumination from two or more lamps, and discussed the variations of illumination in a street between the places of maximum and the places of minimum illumination. Twelve years ago I described a tangent photometer, which has remained a mere optical curiosity.

No one can have worked at the photometry of modern lamps, or of the illumination of surfaces lit by lamps, without becoming conscious how much misunderstanding there is of the elementary laws of illumination. There is Lambert's cosine law, admirable and simple if only it were not in so many cases vitiated by the presence of organised—that is, specular—reflection. There is the law of inverse squares, itself a universal geometrical law of action radiating from a point, so fatally and absolutely misleading if applied to any other case than that of action from a point.

One subject on which more information is badly needed is the specific brightness of surfaces of different kinds when subjected to a standard illumination. For instance, how much light is reflected, per square inch, when illuminated with an intensity of 1 candle-foot, from such materials as oak panelling, whitewash, brown paper, or the surface of a red brick wall? Here in this theatre the walls are tinted of a dark Pompeian red or maroon, which reflects but little light. The extra annual expense on lighting that might be saved had a lighter tint been used is surely worth considering.

The subject of diffuse reflection which here comes into play has indeed been investigated partially by several persons. There are Dr. Sumpner's researches of 1894 and those of Mr. Trotter on white cardboard and other white matt surfaces, but how few others! Again, there is the subject of diffuse refraction, which occurs in ground-glass shades, ribbed and corrugated glass panes, and other devices for diffusing the concentrated light of lamps. Yet how little does any optical book tell us on the subject of diffuse refraction. Reflection and refraction as they occur at dull or irregular surfaces appear to be of no importance to the academic writer of text-books of optics, but they are of vital interest to the illuminating engineer. Again, there are a number of semi-physiological problems that demand investigation and settlement. We all know that our eyes have an automatic diaphragm which stops down the entering light to protect our eyes from glare, rendering us relatively insensitive to bright lights. Does anyone know whether the contraction of the pupil depends on the total amount of light entering the eye or on the intensity of the image on local patches of the retina?

Again, we all know how an unshaded arc-lamp, or even glow-lamp, "cuts" the eyes by the very concentration of its beams, even when it may be many feet away, while the same actual amount of light, if diffused over a greater apparent surface, as by a surrounding globe of ground glass, is quite readily endured, and does not produce the same painful sensation. Does anyone know how great is the specific brightness of surface that the eye will tolerate without experiencing this discomfort? We can look at a white cloud or at the blue sky without pain. Can we endure a specific brightness of so much as one-tenth of a candle per square inch?

Our eyes are provided by nature with a most exquisite and automatic iris diaphragm which opens in the dark and closes in the light, thereby shielding us partially against the evil effects of glare. Putting it in the language which the photographer uses to describe the stopping-down of a camera-lens, the automatic iris of our eye can close the pupil so that while in a comparative darkness the aperture opens to *f*/2 or *f*/2·5, it closes, amid a brilliant surrounding illumination, to about *f*/20. Suppose we are looking out in relative darkness, and are confronted with a brilliant patch shining with a specific brightness of one-tenth of a candle per square inch, we shall feel a certain amount of discomfort from its glare, and if we regard it steadily for a second or two will, on closing our eyes or turning away, see those persistent coloured images that trouble us after looking at any very bright light; but now let the same brilliant patch be placed against a bright background. Far more light will enter the eye; the automatic iris of the eye will in a few moments have contracted, stopping down the lens of the eye so that it will be far less sensitive. In these circumstances, will the patch that has a specific brightness of one-tenth candle per square inch pain or dazzle the eye? I ask the question, but I do not know the answer. Does anyone know what the answer ought to be? It is a simple question, and a few experiments would soon settle it. Of course, one must admit that the automatic action of the iris diaphragm, important as it is, does not by any means account for the whole of the facts about the want of proportion between the intensity of a stimulation and the intensity of the resulting sensation. Fechner's logarithmic law of psychophysics gives a clue, but even this does not seem capable of expressing, much less of explaining, the facts about the observed want of proportionality. Why should a light of ten-fold brilliancy not produce a sensation ten times as intense? And why should a greater brightness of the general surroundings relieve us of the annoyance of those coloured after-images? After-images can be seen even under extremely feeble illumination, as I have again and again found. Has anyone discovered any exact law governing their occurrence?

All these queries show that there is plenty of work awaiting us, even in the mere collection and completion of such scattered information as is already available; but there are even more important questions before us, more important, not in science, but in their relation to the public welfare and the economics of the community.

Now that we have a standard of illumination and simple portable instruments that will measure it, there can be no excuse for inaction or ignorance in applying that knowledge to securing proper illumination for public and private buildings.

Let me begin with school buildings. They are the most important; for whatever bad results flow from bad lighting of churches, factories, or railway stations, those which result from the bad illumination of schools are far more to be deplored—they imperil the eyesight of the next generation.

All ophthalmic surgeons agree that the cause which forces the children into increasing shortsightedness is protracted poring over books under an insufficient illumination. Even in what an inspector might call a well-lit school the illumination at the surface of the desk may be quite insufficient if the desks are badly placed, or the windows insufficiently high, or the lamps badly distributed.

All educational authorities ought henceforth to insist on rational requirements as to lighting. Hitherto they have had nothing definite to specify; now that illumination photometers are available, they ought to require a minimum of $1\frac{1}{2}$ candle-foot at the worst-lighted seat in the schoolroom, and not depend on purely architectural rules about heights of windows or areas of window-space. In England the Board of Education, in its Building Regulation (1907), Rule 6, clause *c*, has laid down a foolish rule:—"Skylights are objectionable. They cannot be approved in school-rooms or class-rooms." That perfectly monstrous provision ought to be at once repealed. The universal experience of the textile industries, where adequate lighting of spinning and weaving machinery is a prime necessity, is that no method of lighting is so satisfactory as skylights in roofs specially constructed to receive light from the northern sky.

Hitherto little attention has been paid by either local or central authorities to conditions affecting the lighting of factories and workshops. It is true that the factory inspectors require periodic whitewashing of factories, but that is for sanitary reasons, not primarily to secure better illumination. The Home Office has its regulations as to temperature and degree of moisture required or permissible in the different classes of factories and workshops. Then why not also similar regulations as to the proper amount of illumination? Surely the eyesight of the workers is as well worth protecting from injury as their lungs and their limbs. So far as I am aware, Holland is the only country in which legislation has fixed a statutory amount of illumination in factories, the figure there being from 10 to 15 candle-metre, equivalent, therefore, broadly to the value of 0·9 to 1·35 candle-foot.

Architects are often blamed for deficiencies in the lighting of the buildings they design, perhaps more often for the deficiencies found at night by artificial lighting than for those of the lighting by day. For this the fault rests no doubt largely with the persons who have installed the lighting arrangements, and one must not blame the architect too severely for having been as ignorant as all the rest of the world about the principles of illumination; but henceforward, when once it is known how much illumination is required in the rooms of different kinds, the architect ought in his specification to set down, with appropriate numerical values, what degree of illumination is required in the various parts of his building.

I venture to suggest that it would be a good thing if, in the public interest, our society, or some committee appointed by it, could draw up a model specification, or model clauses for architects to insert in their specifications, in which the proper way of prescribing the requisite amounts of illumination in different classes of cases should be set forth.

Outside all these matters of more public interest, there are topics enough to occupy our society for many months to come. We shall have discussions on several interesting subjects during next spring, and there are many problems awaiting solution. When all else fails us, we can turn to the eternal question of the measurement of colour. We have also the long outstanding problem of the production of light without heat, accomplished in nature by the fire-fly, but unrealised by any artificial lamp. We might turn to discuss special cases, such as the flashing lights of lighthouses, or the special lights needed in the hospital for the detection of rashes or the treatment of disease. Amid such endless ramifications of our subject there is no fear of coming to a premature end of our programme. There is, indeed, abundance of work before us.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. Baker has been appointed chairman of the examiners for part ii. of the mathematical tripos; Mr. A. Hutchinson, chairman of the examiners for the natural sciences tripos; and Mr. H. W. V. Temperley, chairman of the examiners for the economics tripos, 1910.

Mr. A. E. Shipley has been appointed a manager of the Balfour fund.

Mr. J. E. Purvis has been appointed university lecturer in chemistry and physics in their application to hygiene and preventive medicine for five years.

The Walsingham medal for 1909 has been awarded to Mr. L. J. Wills, for his essay entitled "The Fossiliferous Lower Keuper Rocks of Worcestershire," and a second medal to Mr. H. H. Thomas, for his essay entitled "The Leaves of Calamites (Calamocladus section), with Special Reference to the Conditions under which they Grew."

It is proposed that a grant of 100*l.* be made from the Worts fund to Mr. J. Romanes towards defraying the expense of a journey to Costa Rica with the object of studying the geology and geography of that country.

THE Earl of Crewe, chairman of the governors of the Imperial College of Science and Technology, will distribute the diplomas, medals, and prizes to the successful students at the Royal College of Science on Thursday next, December 16. Prof. Adam Sedgwick, F.R.S., will deliver an address.

DR. H. A. MIERS, F.R.S., principal of London University, will distribute the prizes and certificates at the Sir John Cass Technical Institute, Aldgate, on Thursday, December 16. There will be an exhibition of students' work and apparatus in the laboratories, workshops, and other rooms of the institute.

A CONFERENCE to discuss the needs of technical education in Burma was held at Rangoon early in November. We learn from the *Pioneer Mail* that Mr. J. G. Covernton, Director of Public Instruction, in opening the discussion, presented a brief sketch of what had been done in the past in the way of technical education. He divided the work of technical instruction into two main groups:—(1) those connected with scientific professions, especially engineering; (2) those connected with ordinary country and home life. He proposed that a central technical school for industrial education in the vernacular should eventually be opened at Insein in connection with the engineering school, and related to all the selected vernacular schools for technical education which may hereafter be established, and that pupils who showed special aptitude for technical training should be drafted to this central school. The instruction should be in the vernacular, and its aim be to provide for a general technical training for hand and eye. For trained pupils who might hope to be skilled artisans in various crafts and industries there should, the director said, be local industrial schools in local industries.

THE report for 1908–9 on the work of the Department of Technology of the City and Guilds of London Institute has just been published. It abounds in interesting information concerning the useful work being accomplished by the department in the way of improving the technical education of the country. At the last examinations held by the department, 23,399 candidates were presented in technology from 404 centres in the United Kingdom, and of these 13,665 passed. By the aid of advisory committees the institute is enabled, the report points out, to promote useful relations between trade organisations and the schools in which artisans and others receive their technical instruction. The institute, too, has a system of inspection of trade classes by professional experts, and during the session under review 107 centres were visited by members of the institute's staff for the examination, inspection, or organisation of classes. The report also states that the independent criticisms from examiners in wholly distinct subjects show that many teachers, while undoubtedly using their best efforts to acquaint the students with the technical details of their trade, fail to obtain good results owing to their giving instruction on wrong lines, paying too much attention to description and too little to the theory of the subject and to the principles underlying the work in which they are engaged. This may be partially due to lack of experience in teaching and failure to realise the difficulties of their students, and in such cases a visit from an inspector, himself an experienced teacher in the same subject, would often do much to remedy the defects, more especially if the visit can be repeated so as to enable the instructor to avail himself of the inspector's experience from time to time in the difficulties that arise. The institute also concurs in a suggestion, made by its inspectors, that if the education authority could send a comparatively inexperienced teacher to visit some of the schools at which successful classes are conducted and see their methods of work, such a visit would amply repay its cost.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 25.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir W. de W. **Abney**: The change in hue of spectrum colours by dilution with white light. The author shows that by diluting the spectrum colours from the red to the green-blue with moderate percentages of white light, their hue travels towards the yellow, the change being dependent on the amount of red and green existing in the white added. At a point near λ 5780 the hue remains unaltered by the addition of white, and it is towards this point in the spectrum that the colours on each side of it travel. It is pointed out that this change in hue enables the relative amounts in green and red from λ 5000 to λ 6000 to be accurately determined.—Prof. G. E. **Hale** and F. **Ellerman**: The nature of the hydrogen flocculi and their structure at different levels in the solar atmosphere.—Prof. H. L. **Callendar** and H. **Moss**: The boiling point of sulphur corrected by reference to new observations on the absolute expansion of mercury.—C. **Cuthbertson** and Maude **Cuthbertson**: The refraction and dispersion of neon. The refractivities of neon (Ne_2) for different wave-lengths are found experimentally to be

$\lambda \times 10^8$	$(\mu - 1)10^6$
6438	134·02
5461	134·30
4800	134·63

These can be expressed by the formula

$$\mu - 1 = \frac{5·133 \times 10^{27}}{38517 \times 10^{27} - n^2}$$

where n is the frequency V/λ. Owing to the feebleness of the dispersive power of neon, the accuracy of the value obtained for the dispersion is not to be relied on to less than 5 per cent. Revised formulæ for the refractive indices of helium, argon, krypton, and xenon are given, in the same form, which supersedes the use of Cauchy's formula.—C. **Cuthbertson** and Maude **Cuthbertson**: The refraction and dispersion of air, oxygen, nitrogen, and hydrogen, and their relations. The refractivities of these gases for different wave-lengths are found experimentally to be

$\lambda \times 10^8$	$(\mu - 1)10^6$			
	Air	Oxygen	Nitrogen	Hydrogen
6563	291·92	269·75	298·16	138·66
5790	292·98	270·99	—	139·33
5461	293·60	271·70	299·77	139·71
4861	295·11	273·45	301·21	140·64

Cauchy's formula of two terms is shown to be inadequate to express the dispersion of a gas, and a formula of Sellmeier's type is adopted,

$$\mu - 1 = \frac{C}{n_0^2 - n^2}.$$

In this form the refractivities of these gases are given by the constants shown in the table below. Revised values of the indices of sulphur, phosphorus, and mercury, expressed in the same form, are also given, and it is shown that, on the electronic theory of dispersion, the relative numbers of "dispersion electrons" in hydrogen, oxygen, and nitrogen are as 1, 2, and 3 almost exactly; in sulphur and phosphorus, to a less degree of accuracy, as 3 and 4½. In mercury the number is in the neighbourhood of 4½ to 5.

	$C \times 10^{-27}$	$n_0^2 \times 10^{-27}$	V	C/V
Air	4·6463	16125	—	—
Hydrogen	1·692	12409	1	1·692
Oxygen	3·397	12804	2	1·699
Nitrogen	5·0345	17095	3	1·678
Sulphur	4·808	4600	3	1·603
Phosphorus	7·61	6534	4½	1·691
Mercury ... to	7·82 8·371	4360 4740	4½ 5	1·74 1·68

—C. **Cuthbertson** and Maude **Cuthbertson**: The refraction and dispersion of sulphur dioxide and hydrogen sulphide, and their relation to those of their constituents. The refractivities of sulphur dioxide for different wave-lengths are found experimentally to be

$\lambda \times 10^8$	$(\mu - 1)10^6$
6700	656·40
6500	657·10
5800	661·26
5461	663·97
5000	668·63

These can be expressed in a formula of Sellmeier's type,

$$\mu - 1 = \frac{5·728 \times 10^{27}}{8929 \times 10^{27} - n^2}.$$

The refractivities of hydrogen sulphide for different wave-lengths are found experimentally to be

$\lambda \times 10^8$	$(\mu - 1)10^6$
6563	636·22
5790	641·17
5461	644·03
4861	650·98

These can be expressed in the same form by

$$\mu - 1 = \frac{4·834 \times 10^{27}}{7808 \times 10^{27} - n^2}.$$

The number of "dispersion electrons" in SO_2 is shown to be approximately equal to the sum of the numbers of "dispersion electrons" in S_1 and in O_2. The number of "dispersion electrons" in H_2S is, approximately, one more than the sum of the "dispersion electrons" in H_2 and in S_1.—Prof. M. F. **Fitzgerald**: Flapping flight.—Dr. W. **Rosenhain** and J. C. W. **Humfrey**: The crystalline structure of iron at high temperatures. The paper contains a preliminary account of observations on the effects of strain on iron at high temperatures. Polished strips of nearly pure iron were heated *in vacuo* and strained while hot, the central portions of the specimen attaining a temperature of about 1100° C., while the ends remained below visible redness. Heating alone produced a surface pattern caused by a volume change in the metal when passing through the $\alpha = \beta$ transformation, and occasionally where the temperature was highest a slight tarnish which revealed the γ crystals. Heating and straining *in vacuo* showed that at all temperatures attained deformation took place by means of slip on the gliding planes of the crystals; three distinct regions could, however, be distinguished, and temperature estimations by the method of Joly's meldometer agree with the identification of these regions with the α, β, and γ ranges of Roberts-Austen. This identification is supported by differential heating and cooling curves given in the paper. In the α range the number and intensity of slip-bands increases rapidly with increasing temperature; at the transition point—which is seen as a well-defined line across the specimen—the bands suddenly cease and remain minute during the β range; in the γ range the bands are again numerous, but differ from those observed in the α range by their straightness and regularity and by the frequent occurrence of twin crystals. These observations are illustrated by three photomicrographs. The authors consider that their observations strongly support the allotropic theory of Roberts-Austen, particularly since they show that β iron, although at a higher temperature, is markedly harder and stronger than α iron. So much is this the case that when such a specimen was broken while hot, the fracture took place in the region of hottest α iron, just before the transition point. The present observations also demonstrate the similarity of γ iron, as found in nearly pure iron when heated, with the well-known "γ iron" found in alloy steels.—Dr. A. E. H. **Tutton**: The relation of thallium to the alkali metals: a study of thallium-zinc sulphate and selenate. This communication contains the results of an investigation of the thallium salts of the zinc group of the monoclinic series $R_2M\left(\begin{matrix}S\\S_e\end{matrix}O_4\right)_2.6H_2O$, analogous to the previous investigation of the simple rhombic salts of the series $R_2\begin{matrix}S\\S_e\end{matrix}O_4$. The conclusions formed as the result of the latter research are fully confirmed and independently substantiated, as regards the relations of thallium to the alkali metals and ammonium, and the nature of the isomorphism existing between the salts of these various bases. A large number of crystal measurements and determinations of physical constants are recorded in the paper. The main conclusion is that the morphological and physical properties of the crystals of these thallium double salts are such as quite entitle them to inclusion in the monoclinic isomorphous series of the general formula above given, but not to places in the more exclusive eutropic series within that isomorphous series. This eutropic inner series is confined to the salts the interchangeable metals of which belong to the same family group of the periodic classification, namely, to those of potassium, rubidium, and cæsium, the crystals of which exhibit the regular progression of angles and physical constants, according to the atomic weight of the metal, already pointed out by the author in previous communications. The crystals of the thallium salts resemble very closely those of the ammonium salts—which are also outside the eutropic series, but are included in the isomorphous series—except as regards one outstanding specific property, that of refraction; for the crystals of the thallium double salts, like those of the simple sulphate and selenate of thallium, exhibit transcendent refractive power, which proves to be a characteristic property of the crystals of all the thallium salts yet studied by the author.—P. F. **Everitt**: The nature of the diffraction figures due to the heliometer. This paper contains a discussion of the heliometer diffraction fringes. The matter is one of considerable importance, owing to its bearing on astronomical measurements taken with this instrument. A difficulty arose owing to the appearance of these fringes in heliometer work on an artificial double star. It was then found that, although the subject had been discussed by Bessel, Hansen, and Gauss, a good photograph of the actual fringes obtained by Scheiner and Hirayama, and a series given for the calculation of the fringes by Bruns, all attempts at their actual numerical determination had failed, owing to the extremely slow convergence of the series adopted, at a small distance from the centre of the system. By the adoption of a semi-graphic method, and the use of mechanical integrators, it has been found possible to carry out the calculations needful in order to obtain an accurate picture of the fringes. Photographs were taken of the fringes, and these, taken by the author, as well as the photograph taken by Scheiner and Hirayama, show a close agreement with the calculated contours, and enable one to obtain the proportions of the central (non-elliptic) oval, with which observers are chiefly concerned. The close agreement between the calculated and theoretical values of the different parts of the system is a further proof that the old undulatory theory suffices to determine in practice the true dimensions of such diffraction figures.—E. **Cunningham**: The motional effects of the Maxwell æther-stress. There is an outstanding gap in electromagnetic theory in respect to the attempt to reconcile the analysis of æthereal stress on the lines initiated by Maxwell with Newton's third law and with the law of the conservation of energy. In the present condition of theory there are assigned to the æther certain distributions of electromagnetic energy and momentum. The hypothetical distribution of energy is necessarily associated with the Poynting vector which measures its rate of transference. The distribution of momentum is so defined that the rate of increase of the total amount within any given volume supposed at rest in the æther is equivalent to the resultant of the Maxwell stresses on the bounding surface. There is, however, no connection established between the transference of energy across an area and the stress across that area. Such a connection would require that it should be possible to assign to the medium in which stress and energy reside a state of motion whereby the stresses might do the necessary amount of work; and this, again, would require the revision of the specification of stress, inasmuch as the ordinary expressions are computed for an element of surface which is at rest. In the first section of the present paper it is shown that, if g is the intensity of electromagnetic momentum ($[EH]/4\pi c$) and w the energy intensity ($[E^2+H^2]/8\pi$), and the velocity v is taken in the direction of g of magnitude, such that $(c^2+v^2)g=2v\mathrm{W}$, the same stress system which would account for the transfer of momentum will account for the transfer of energy, provided the æther is assumed to be moving with velocity v. The stress system is not the ordinary Maxwell one, but reduces to it in the electrostatic case. In this case it is known that the Maxwell stress may be analysed into a tension along the lines of force, together with a uniform pressure at right angles to those lines. This property of the stress system, commonly given, is not true of the total stress (electric and magnetic) in the general field. It is shown, however, that the stress system obtained in the paper can always be reduced to this form. The direction of one of the principal stresses is always along the velocity v. It is shown, further, that at the surface of a perfect reflector, stationary or moving, the velocity v is equal to that of the reflector combined with a velocity tangential to it, that is to say, a perfect reflector is analogous to an impenetrable boundary. In the second part of the paper a similar analysis is applied to radiation such as would exist in the interior of a cavity the walls of which are moving, so that, although the electric and magnetic forces vary extremely rapidly and in an irregular manner, there is necessarily a transfer of energy. Taking ϵ and γ as the mean values of the energy and momentum over intervals of time, which are short as compared with those which are appreciable by mechanical means, but long as compared with the period of the irregular fluctuations which constitute natural radiation, it is found that the mechanical properties of the radiation may be represented as those of a continuous quasi-fluid, in which there is a definite pressure p at every point (the same in all directions) and a definite velocity v, the relations connecting the several quantities being

$$3p=\epsilon-v\gamma \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$c^2\gamma=v(\epsilon+p) \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

If a small volume V is followed in its motion with the quasi-fluid, it is found that the quantity

$$p\mathrm{V}^{4/3}(c^2-v^2)^{-2/3} \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

remains constant. If v^2 is neglected this becomes the known equation connecting the pressure and volume of steady radiation for adiabatic changes. Finally, it is shown that if a state of the radiation differing slightly from the actual is conceived, and dQ is the difference in the energy of the small volume V, after allowing for the change due to mechanical causes, such as increase of momentum and volume, the condition that the expression dQ/T should be a perfect differential is that

$$p(c^2-v^2)^2=k\mathrm{T}^4 \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

This with (3) involves the equation

$$p\mathrm{V}/\mathrm{T}=\text{constant}.$$

—Dr. H. C. **Pocklington**: The aberrations of a symmetrical optical instrument. The doubly modified characteristic function is written down, and the singly modified function derived from it correct to terms of the fourth order of small quantities. This is transformed so as to take account of the existence of an exit pupil, and formulæ are found giving the aberrations for any position of the object and pupil in terms of the six coefficients of aberration of the system. Some relations are found between these aberrations, and connection is established with the methods of numerical calculation given in Whittaker's tract on "The Theory of Optical Instruments."—H. E. **Watson**: The spectrum of radium emanation.—Prof. E. G. **Hill** and Dr. A. P. **Sirkar**: The electric conductivity and density of solutions of hydrogen fluoride.—Sir David **Bruce**, Captains A. E. **Hamerton** and H. R. **Bateman**, and Captain F. P. **Mackie**: Sleeping sickness in Uganda. Duration of the infectivity of the *Glossina palpalis* after the removal of the lake-shore population.

Institution of Mining and Metallurgy, November 18.—Mr. Edgar Taylor, president, in the chair.—L. D. **Ricketts**: Experiments in reverberatory practice at Cananea, Mexico. A detailed description of the installation of a reverberatory furnace and McDougal calciners at the Cananea Consolidated Copper Co.'s Works, and of the difficulties that were encountered in connection with the fuel available. The coal that was obtainable was of so unsuitable a quality that, after experiments with it whole and pulverised, none of which was attended with success, recourse was had to oil fuel. A feature of the smelting operation is the relatively large proportion of flue dust treated. Full details are given of the quantities of materials treated and of the costs of the various operations, and the author goes minutely into the circumstances attending the failure of the coal-firing and difficulties encountered during that and the subsequent oil-firing. The paper is principally composed of observed facts.

Physical Society, November 26.—Dr. C. Chree, F.R.S., president, in the chair.—Dr. J. W. **Nicholson**: The effective resistance and inductance of a helical coil. This paper deals with a determination of the effective resistance and inductance of a helical coil of great length, composed of thin wire, wound on a cylinder the radius of which is large in comparison with that of the wire. The pitch of the winding is not small, so that the problem cannot be treated by the method of Cohen. The method employed depends upon the use of a type of "helical coordinates" defining the position of any point, and of the general theorem relating to orthogonal systems of coordinates. A solution is obtained for the internal and external forces, corresponding to a given impressed electromotive force, in the form of a Fourier series of which only the initial terms require calculation. The value of the effective current across any section is obtained, and thence the inductance and resistance. For a high frequency it is found that the change of self-inductance due to twisting of the wire tends to vanish, and that the change of resistance tends towards a value independent of the frequency.—W. A. **Scoble**: Ductile materials under combined stress. The author further considers the results from some earlier tests made on mild steel bars, ¾-inch diameter and 30 inches effective length, under combined bending and torsion. It is pointed out that the yield-point is usually selected as the criterion of strength, because it is more easily determined than the elastic limit, it is less affected by special treatment of the material, and it is assumed that the failure of Hooke's law between the elastic limit and the yield-point is due to local yielding. The elastic limit is the correct point, and is used throughout, because the intermediate state mentioned above does not appear in bending. The results of tests on steel and copper tubes under combined bending and torsion are also given. All the results indicate that the maximum stress and maximum strain laws do not apply to ductile materials. The stress difference or shear stress law is approximately true, but there is, in each case, a deviation from the law which is opposed to the other theories mentioned. The shear stress law appears to state the average behaviour of ductile materials, but there are considerable deviations from the law, which are usually opposed to the other theories. Other tests by the author indicate that brittle materials obey the maximum stress law, and it is therefore suggested that the value of "m" depends chiefly on the degree of ductility of the material considered, and to a lesser extent on the system of loading.—Drs. W. **Makower** and S. **Russ**: The recoil of radium C from radium B. It has been shown in a previous paper that, during a radioactive transformation involving the expulsion of an α particle, the residue of the atom from which the α particle has been expelled recoils in an opposite direction to that in which the α particle is emitted, and can travel a considerable distance through a gas if the pressure is sufficiently low. A similar effect was also demonstrable in the case of the transformation of radium B into radium C, although this transformation is supposed to be accompanied by only β rays. The phenomena associated with this recoil are studied in this paper. In the first place, it was found that it was only in certain circumstances that pure radium C free from radium B was projected from a plate coated with radium B and radium C. Secondly, the active deposit on a plate appears to be concentrated into heaps, so that radium C, in breaking up, mechanically carries with it some radium B. If, however, sufficient time is allowed after removing a plate from the emanation for Radium A to decay completely, and if, further, sufficiently small quantities of deposit are used to avoid the formation of heaps, practically pure radium C is emitted. The law according to which the radiation fell off with distance was also studied, and it was found that radium C is not emitted from an active plate equally in all directions, a greater quantity being emitted normally to the plate than in directions making an angle with the normal. The absorption by air of radium C when it recoils from radium B was investigated. It was found that about half the radium C projected from a plate was stopped by 2·5 cm. of air at a pressure of 0·04 mm. mercury. Since radium B emits only β particles, the energy of recoil in this case should be less than one-millionth of the energy of recoil in a transformation in which an α particle is emitted. The fact that the penetration of radium C when it recoils is as much as one-fortieth of that previously found for radium A and radium B is therefore surprising.—Dr. C. V. **Burton**: The sun's motion with respect to the æther. Notwithstanding the well-known "principle of relativity," it is theoretically possible to determine the motion of the solar system with respect to the æther from observations of the eclipses of Jupiter's satellites, and the possibility was indicated by Maxwell some thirty years ago. For convenience, the motion of the æther with respect to the sun may be called a wind, and the method proposed is based on the consideration that the tidings of an eclipse will travel towards us more rapidly when the Jovian system is to windward of us than when it is to leeward. The residual discrepancies between the observed and calculated times of eclipses have to be analysed for systematic differences depending on the direction in space of the straight line drawn from the earth to Jupiter, and formulæ are given for finding by the method of least squares the most probable values of a, b_1, c_1, the components of the sun's velocity with respect to the æther. The material available is to be found in Prof. R. A. Sampson's discussion of the Harvard photometric eclipse observations, about 330 eclipses of Jupiter's satellite I. being included. In order to obtain a preliminary notion of the accuracy to be expected, a simplified system has been considered in which (for one thing) the eccentricity of the orbits was virtually neglected, and it appears that some advantage is to be gained by taking the plane of Jupiter's orbit, rather than the ecliptic, as one of the coordinate planes. The axis of x is drawn from the sun's centre through the node of Jupiter's orbit, the axis of y lying also in that orbit, and the axis of z being perpendicular thereto. Taking 4·5 seconds as the "probable" discrepancy between theory and observation for a single eclipse, the following preliminary estimates are obtained:—probable error in $a=43{\cdot}6$ km. per second; probable error in $b_1=45{\cdot}6$ km. per second; probable error in $c_1=10{,}000$ km. per second.

Royal Anthropological Institute, November 30.—Dr. A. C. Haddon, F.R.S., in the chair.—Canon **Greenwell** and the Rev. R. A. **Gatty**: Pit-dwellings at Holderness. An interesting discovery of pit-dwellings has been made by Mr. William Morfitt, of Atwick, near Hornsea, in Holderness. Mr. Morfitt for the past twenty years has devoted his attention to these dwellings, which are excavated 5 feet deep in the Boulder-clay, and are covered by an unbroken surface soil to the depth of 18 inches. The pits are filled with black mud, which on being removed discloses the original floor of the dwelling, with its hearth and broken pottery, the remains of past feasts in the form of broken bones, and the rude flint tools of the dwellers, for no well-shaped implement has come to light. About thirty of these dwellings have been examined and the pottery restored. Their great antiquity is proved by the fact that long after the inhabitants had ceased to occupy the pits, and mud had filled them up, a surface soil had formed to the depth of 18 inches, upon which late Neolithic implements and bronze implements have been found. This shows the dwellers to have been earlier than the Bronze age. The pottery is of the rudest kind, with no decoration. The bones remaining from the feasts include those of red deer, horse, Celtic ox, goat, and pig. Although the pits are now close to the sea, no fish bones or shells have been found in them, which proves that when they were occupied their position was far inland. The rapid demolition of the land by the sea in this part of Holderness accounts for this, but it also shows that a long period of time must have elapsed. In all probability these pit-dwellings are among the earliest habitations of Neolithic man which have been found in England. Prof. Boyd Dawkins was present when a fall of cliff had exposed one of these pits on the estate of Colonel Haworth Booth, and verified the fact that the surface soil covering the pit was unbroken, and must have been deposited after the pit had become filled with mud.

Faraday Society, November 30.—Mr. James Swinburne, F.R.S., president, in the chair.—Dr. H. J. H. **Sand**: The electroanalytical determination of lead as peroxide. This investigation was carried out with the object of elucidating the cause of the discrepancy between the statements of various experimenters regarding the behaviour of an electrolytic lead peroxide deposit on drying at 200°. All authors agree that the peroxide deposit retains water at this temperature, but whereas Hollard and Bertiaux give an analytical factor of 0·853, most other investigators find a factor of approximately 0·864, the theoretical factor being 0·866. Incidentally, the effect of varying conditions on the coherence of the deposit was also studied. It was found that at 200° a lead peroxide precipitate is capable of absorbing moisture from a damp atmosphere, and an increase of as much as 1·7 per cent. of the weight of the deposit has thus been obtained. On heating in a dry atmosphere at the same and higher temperatures the peroxide loses its water exceedingly slowly.—A. **Jaques**: The influence of dissolved gases on the electrode potential in the system of silver—silver acetate, aq. Variable values were found for the E.M.F. of the cell

$$\mathrm{Ag} \mid \mathrm{AgC_2H_3O_2}, x\mathrm{N} \mid \mathrm{NH_4NO_3}, \text{sat.} \mid 0{\cdot}1\ \text{N.E.},$$

and the variations were traced to the presence of dissolved air in the silver acetate solution. Measurements were made with saturated and 0·5 N silver acetate solutions saturated with hydrogen, oxygen, nitrogen, and carbon dioxide respectively, and reproducible values were obtained for the solution saturated with hydrogen which agreed with those calculated from the determinations of the E.P. of silver by G. N. Lewis and by Brislee. The values for solutions saturated with carbon dioxide also approximated to this. On blowing hydrogen into the solution saturated with carbon dioxide the potential fell about 30 millivolts, then gradually rose to about the normal value. With oxygen and nitrogen equal values were obtained—about 20 millivolts below that found with hydrogen. In 0·01 N silver acetate saturated with hydrogen the values were not reproducible. Similar measurements with 0·1 N silver nitrate and 0·5 mol. N lead acetate and lead nitrate showed that in these solutions the electrode potential is practically unaffected by the presence of dissolved gases.—A. **Jaques**: Contributions to the study of ionisation in aqueous solutions of lead acetate and cadmium acetate. From measurements of electrode potentials in solutions of lead and cadmium acetates, and their freezing points, and the solubility of silver acetate in them, it appears that in dilute single solutions ionisation occurs chiefly, though not entirely, according to the scheme

$$\mathrm{M(C_2H_3O_2)_2 \rightleftharpoons MC_2H_3O_2 + C_2H_3O'_2}$$
$$\mathrm{MC_2H_3O_2 \rightleftharpoons M^{\cdot\cdot} + C_2H_3O'_2},$$

where M represents Pb or Cd. Approximate values for the corresponding dissociation constants are calculated.—Prof. F. G. **Donnan** and Dr. G. D. **Hope**: The calorimetrical analysis of hydrated salts. The authors point out that the interpretation of the heats of solution of hydrated and partially dehydrated salt given by Thomsen in his "Thermochemische Untersuchungen" is in various cases either erroneous or unsatisfactory. It is shown that Thomsen's data for sodium carbonate indicate, when correctly interpreted, the existence of only the hydrates with 1, 7, and 10 mols. water per mol. anhydrous salt. The authors' experiments confirm this result. In the case of copper sulphate, neither the experiments of Thomsen nor those of the authors indicate more than the existence of the hydrates $\mathrm{CuSO_4{\cdot}5H_2O}$ and $\mathrm{CuSO_4.H_2O}$, though the hydrate $\mathrm{CuSO_4{\cdot}3H_2O}$ is known to exist.

Linnean Society, December 2.—Dr. D. H. Scott, F.R.S., president, in the chair.—Sir Charles **Eliot**: Nudibranchs from the Indian Ocean.—Dr. Georg **Ulmer**: Trichoptera von Mr. Hugh Scott auf den Seychellen gesammelt.—Dr. W. H. **Dall**: Report on the Brachiopoda obtained from the Indian Ocean by the *Sealark* Expedition, 1905.—Prof. J. S. **Gardiner** and others: Narrative of the *Sealark* Expedition, part iii.

Paris.

Academy of Sciences, November 29.—M. Bouchard in the chair.—L. **Maquenne** and M. **Demoussy**: The blackening of green leaves. The blackening of leaves by the ultra-violet rays is not due to a specific action of this radiation; it takes place equally under all influences which determine the death of the protoplasm, such as heat, chloroform, or mechanical rubbing. This phenomenon is a consequence of diastatic action, and falls into the same category as the facts observed for the first time by M. Guignard in his researches on the localisation of plant principles.—A. **Witz**: The regeneration of the exhaust gases from internal-combustion motors. The author suggests that the exhaust gases, taken from the cylinder without cooling, should be passed over a column of incandescent coke. The gas thus produced, containing carbon monoxide, is washed and re-admitted with pure oxygen to the gas-engine cylinder. It is assumed that the price of the oxygen, prepared from liquid air, is now sufficiently low for use in this manner commercially. The utilisation of the heat in the exhaust gases is calculated to give an economy of about 30 per cent.—S. **Arloing**: Antituberculous vaccination in the ox. An account of the practical results which have been obtained in the direction of obtaining immunity against tuberculosis in cattle in experiments which have been carried on for more than twenty-five years.—M. **Jarry-Desloges**: The period of rotation of Mercury. The surface of Mercury presents a certain number of dark spots, often well defined. The chief difficulty in perceiving these is the bad quality of the telescopic images. The rotation of Mercury from these observations would appear to occupy a long period, and is probably equal to the time of revolution.—Robert **Jonckheere**: Study of the planet Mars at the Observatory of Hem. Details are given of observations taken between July 16 and November 1 of this year.—Jean **Merlin**: Algebraical equations.—M. and Mme. Paul **Dienes**: Algebraico-logarithmic singularities.—Frédéric **Riesz**: Linear functional operations.—L. **Lichtenstein**: The determination of the integrals of the equation

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + a\frac{\partial u}{\partial x} + b\frac{\partial u}{\partial y} + cu = f.$$

—H. **Pellat**: The bifilar pendulum. A supplementary note to a recent paper on this subject dealing with the error introduced by the defective flexibility of the suspending metallic ribbons.—H. **Merczyng**: Studies on very short electromagnetic waves. Reflection and anomalous dispersion of liquids. These measurements necessitated the exact determination of the wave-length of the electromagnetic waves, and the method based on the dimensions of the vibrators not being sufficiently accurate, an interference method was worked out. The dielectric constants with these short waves (4·5 cm.) and the optical refractive indices were compared for several liquids, including glycerin, methyl and amyl alcohols, acetic acid, aniline, and ethyl ether.—Edm. **van Aubel**: The production of ozone under the influence of ultra-violet light. Experiments are described proving that ozone is formed by the rays from a quartz mercury lamp.—Laurent **Raybaud**: The destructive effect of the solar radiation. An account of the action of various radiations on cultures of *Phycomyces nitens*.—Georges **Meslin**: Magnetic dichroïsm and the orientation of crystals of siderose in the field.—Edmond **Bauer** and Marcel **Moulin**: The constant in Stefan's law. A possible source of error in the determination of this constant by M. Féry is pointed out, and the constant re-determined. The value $6{\cdot}0 \times 10^{-12}$ is considered to be correct within 1 per cent.—E. **Rengade**: The theoretical form of the cooling curves of binary mixtures: the case of mixed crystals.—Paul **Sacerdote**: Changes in the colour of the diamond under the action of various physical agents. The

X-rays do not sensibly modify the colour of the diamond, but considerable change is brought about by the action of the kathode rays, the diamond developing a yellow tint. This tint is permanent at the ordinary temperature, but an exposure to a temperature of 300° to 400° C. rapidly restores the original tint.—André **Meyère**: The influence of radium, the X-rays, and the kathode rays on various precious stones. The stones examined in these experiments were the diamond, and white, blue, and rose corundums. One effect only was produced by all three radiations—the stone became more or less tinted yellow.—J. B. **Senderens**: The catalytic preparation of unsymmetrical fatty ketones. Thoria is the most suitable catalyser for the purpose of these experiments, and is employed at a temperature of 400° to 430° C. A mixture of fatty acids passed over this reagent gives the ketone according to the equation

$$\mathrm{R.CO.OH+R'.CO.OH=R.CO.R'+CO_2+H_2O.}$$

Small quantities of the two symmetrical ketones are formed simultaneously, but the three ketones are readily separated by fractional distillation.—G. **Vavon**: Hydrogenations in the terpene series. Pinene rapidly absorbs hydrogen in the presence of platinum black, giving a nearly quantitative yield of the hydrocarbon $C_{10}H_{18}$. Camphene and limonene behave similarly. In alcoholic solution hydrogen can be added in this way to maleic, fumaric, and cinnamic acids, and to erucic acid in ethereal solution.—T. **Klobb**: The phytosterols from the flowers of *Tussilago farfara*. Two new alcohols are described, one being a monovalent phytosterol, the other divalent and resembling arnidiol in its behaviour.—Georges **Darzens**: The catalytic hydrogenation of the quinoline and aromatic bases. The exact temperature at which the nickel oxide is reduced, and the temperature at which the catalysis is carried out, are the two essential factors in the successful reduction of quinoline and aromatic bases. The preparation of tetrahydroquinoline is described.—Paul **Gaubert**: The polychroism of artificially coloured crystals.—H. A. **Brouwer**: Certain lujaurites from Pilandsberg, Transvaal.—Lucien **Daniel**: A new graft hybrid.—F. **Bordas** and M. **Touplain**: An anaëroxydase and a catalase in milk. Repeating some work of M. Sarthou, the authors come to the conclusion that the existence of an anaëroxydase and a catalase in cow's milk has not been demonstrated; the colour reactions produced in milk on treatment with hydrogen peroxide are due to casein or its compound with lime.—L. **Cuénot** and L. **Mercier**: Studies on the cancer of mice. Relation between the grafting of the tumour, gestation, and lactation.—C. **Levaditi** and K. **Landsteiner**: The transmission of infantile paralysis to the chimpanzee.—Jacques **Pellegrin**: A new parasitic fish of the genus Vandellia.—A. **Gruvel**: The dispersion of some species belonging to the marine fauna of the coasts of Mauritania.—Paul **Lemoine**: The subterranean folds of the Gault in the Paris basin.—André **Delebecque**: The origin of the plain of Rocailles (Haute Savoie).—M. **Répelin**: The *rôle* of the most recent dislocations (post-Miocene) in the earthquake of June 11, 1909.

DUBLIN.

Royal Irish Academy, November 8.—Dr. F. A. Tarleton, president, in the chair.—Dr. R. F. **Scharff**: The evidences of a former land-bridge between northern Europe and North America. The author explained that he was only dealing with the most recent land-bridge of which we had any evidence between the two continents. The testimony in favour of this theory is of a two-fold character. It is based on an investigation of the sea-floor and on a study of the plants and animals of the countries supposed to have been joined to one another by land. The author alluded principally to the continental shelves and to the researches of Prof. Hull, Dr. Spencer, and Dr. Nansen. He also brought forward botanical and zoological evidence pointing to the existence of a former continuous land surface between north-western Europe and eastern North America. The theory of accidental transport of species across the ocean was especially commented upon and discussed, but the author was inclined to adopt the view that the similarity between the fauna and flora of the two continents was mainly due to a pre-Glacial land-bridge connecting Scotland with the Færöes, Iceland, Greenland, and Labrador.

NEW SOUTH WALES.

Linnean Society, September 29.—Mr. C. Hedley, president, in the chair.—E. W. **Ferguson**: Revision of the Amycteridæ (Coleoptera), part i., the genus Psalidura. The family Amycteridæ comprises several groups of hard-shelled, apterous, and solely terrestrial weevils. The genus Psalidura comprises the group the distinguishing character of which is that the males possess anal forceps. The previously described species, numbering 37 in Masters's Catalogue, have been revised, and reduced to 24, to which number 22 new species are added, making a total of 46 species. Of these, it has not been possible to examine any specimens of four species, of which three—*P. D'urvillei*, *P. mirabunda*, and *P. squalida*—were described originally from female specimens only (and the descriptions are, therefore, almost valueless).—T. H. **Johnston**: The Entozoa of monotremes and Australian marsupials.—T. H. **Johnston** and Dr. J. B. **Cleland**: Notes on some parasitic Protozoa.—J. H. **Maiden** and E. **Betche**: Notes from the Botanic Gardens, No. 15, on a plant, in fruit, doubtfully referred to Cymodocea.

October 27.—Mr. C. Hedley, president, in the chair.—A. M. **Lea**: Revision of Australian Curculionidæ, subfam. Cryptorhynchides, part x. The tenth instalment of the revision continues the consideration of the genera allied to Chætectetorus, all of them belonging to the "Cryptorhynchides vrais" of Lacordaire. Twelve genera, and thirty-eight species, including fifteen proposed as new, are described.—A. F. B. **Hull**: The birds of Norfolk and Lord Howe Islands. The number of species actually known to breed at the present time amounts to twenty-nine for Norfolk and twenty-one for Lord Howe Island.—R. J. **Tillyard**: Studies in the life-histories of Odonata. No. 3. Notes on a new species of Phyllopetalia, with descriptions of nymph and imago. The species here named *Phyllopetalia patricia*, n.sp., was described by the author in 1906 under the name of *P. apollo*, Selys. Further investigation has shown it to be possessed of a number of important peculiarities, marking it out as a distinct species. The discovery of the nymph by Mr. Keith Brown at Leura, Blue Mountains, is of the greatest importance to ontogenists, as the specimen is the only known form of the Petalia group of dragon-flies. Evidence is brought forward, mainly on the form of the labium, strongly supporting the view advocated by Dr. F. Ris, that the Petalia group is not referable to the Cordulegasterinæ at all (though at present placed in that subfamily), but is an archaic remnant of the true Æschninæ.—Dr. H. I. **Jensen**: Notes on some recent work on the rocks of Samoa. Prof. M. Weber, of Munich, recently published an exhaustive report on the petrography of the Samoan Islands, based upon the examination of a very complete series of rocks collected by Herr J. Friedländer in 1907. Additional light is thrown upon two problems discussed in the author's two papers on the geology of Samoa, &c., in the Proceedings for 1906 (p. 164) and 1907 (p. 706), namely, the significance of the case of a recently erupted basalt which, on analysis, showed a higher soda content than was to be expected from the results of the petrological examination; and the bearing of the subalkaline composition of the Samoan lavas now established by Weber, upon the hypothesis that the eruptions along the Samoa-Tonga-Taupo line depend upon an earth-folding movement (*loc. cit.*, 1906, pp. 661–2).

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 9.

ROYAL SOCIETY, at 4.30.—The Hexosephosphate formed by Yeast-juice from Hexose and Phosphate: W. J. Young.—On the Presence of Hæm-agglutinins, Hæm-opsonins, and Hæmolysins in the Blood obtained from Infectious and Non-infectious Diseases in Man (Third Report): L. S. Dudgeon and H. A. F. Wilson.—Gametogenesis of the Gall-fly *Neuroterus lenticularis* (*Spathegaster baccarum*). Part I.: L. Doncaster.—Preliminary Note upon the Cell Lamination of the Cerebral Cortex of

Echidna, with an Enumeration of the Fibres in the Cranial Nerves: Dr. E. Schuster.—Cortical Lamination and Localisation in the Brain of the Marmoset: Dr. F. W. Mott, F.R.S., Dr. E. Schuster, and Prof. W. D. Halliburton, F.R.S.—The Caudal Fin of Fishes (Preliminary Paper): R. H. Whitehouse.—Some Experiments with the Venom of *Causus rhombeatus*: H. E. Arbuckle.—On the Comparative Action of Stovaine and Cocaine as measured by their Direct Effects upon the Contractivity of Isolated Muscle: Dr. V. H. Veley, F.R.S., and Dr. A. D. Waller, F.R.S.—*Glossina palpalis* as a Carrier of *Trypanosoma vivax* in Uganda: Colonel Sir David Bruce, C.B., F.R.S., Captains A. E. Hamerton and H. R. Bateman, R.A.M.C., and Captain F. P. Mackie, I.M.S.—A Critical Study of Spectral Series. Part I., The Alkalies, H and He: Prof. W. M. Hicks, F.R.S.—On the Distribution of the Röntgen Rays from a Focus Bulb: G. W. C. Kaye.—On the Nature of the Ionisation of a Molecule by an *a* Particle: R. D. Kleeman.—Conduction of Heat through Rarefied Gases: F. Soddy and A. J. Berry.—Harmonic Tidal Constants for Certain Chinese and New Zealand Ports: T. Wright.—The Photographic Action of the *α* Particles emitted from Radio-active Substances: S. Kinoshita.

Mathematical Society, at 5.30.—Exhibition of an Instrument for Solving Cubic Equations: T. H. Blakesley.—The Connection between the Theories of the Singularities of Surfaces and Double Refraction: A. B. Basset.—On the Representation of a Group of Finite Order as a Group of Linear Substitutions with Rational Coefficients: Prof. W. Burnside.—The Eliminant of the Equations of Four Quadric Surfaces: A. L. Dixon.

Institution of Electrical Engineers, at 8.—Notes on Methods and Practice in the German Electrical Industry: L. J. Lepine and A. R. Stelling.

Royal Society of Arts, at 4.30.—The Punjab: Sir James Wilson, K.C.S.I.

FRIDAY, December 10.

Royal Astronomical Society, at 5.—On certain Families of Periodic Orbits: Sir G. H. Darwin.—Description of a Field Method for the Determination of Latitude with a Theodolite: N. S. Bartlett.—Southern Double Star Measures: G. D. Hirst.—Note on certain Coefficients appearing in the Algebraical Development of the Perturbative Function, Second Paper: R. T. A. Innes.—On the Modern Theory of Aberration: H. C. Plummer.—*Probable Paper*: On the Diagrammatic Representation of Proper Motions: H. H. Turner.

Malacological Society, at 8.—Note on the very young Stage of the Genus Humphreyia: G. A. Smith.—A Further Note on the Anatomical Differences between the Genera Cypræa and Trivia: H. O. N. Shaw.—A New Mexican Genus of Pleuroceratidæ: Prof. H. A. Pilsbry.—Notes on a Collection of Terrestrial Land Shells from Angola, with Description of New Species: H. B. Preston.—Notes on the Genus Libera: J. H. Ponsonby.

MONDAY, December 13.

Royal Society of Arts, at 8.—Aëronautics: C. C. Turner.

Royal Geographical Society, at 8.30.—Exploring Journeys in Turkey-in-Asia: Capt. Bertram Dickson.

TUESDAY, December 14.

Zoological Society, at 8.30.—(1) On Change of Colour in a Specimen of *Mellivora ratel* living in the Society's Gardens; (2) A Comparative Examination of Three Living Specimens of *Felis tigris sondaica*, with Notes on an old Javan Male: Dr. F. D. Welch.—The Nesting-habits of *Phyllomedusa sauvagii*: Dr. W. E. Agar.—(1) Marine Fauna from the Mergui Archipelago, Lower Burma, collected by Jas. J. Simpson and R. N. Rudmose-Brown: Madreporaria; (2) Marine Fauna from the Kerimba Archipelago, Portuguese East Africa, collected by Jas. J. Simpson and R. N. Rudmose-Brown: Madreporaria: Ruth M. Harrison and Margaret Poole.—(1) Some Notes upon *Boa occidentalis* and *Boa* (*Pelophilus*) *madagascariensis*; (2) Notes upon the Anatomy of Monkeys of the Genus Pithecia: F. E. Beddard, F.R.S.—On the Ophidian Genus Grayia: G. A. Boulenger, F.R.S.

Institution of Civil Engineers, at 8.—Railway Signalling in India: C. W. Hodson.

Royal Anthropological Institute, at 8.15.—Notes on a Recent Ethnographical Expedition to the Congo: E. Torday.

WEDNESDAY, December 15.

Royal Society of Arts, at 8.—The Diamond Fields of Brazil: H. Pearson.

Royal Meteorological Society, at 7.30.—The Variations of Currents of Air indicated by Simultaneous Records of the Direction and Velocity of the Wind: Dr. W. N. Shaw.—(1) South American Rainfall Types; (2) The Study of Phenomenal Climatology: W. G. Reed.

Geological Society, at 8.—The Metallogeny of the British Isles: A. Moncrieff Finlayson.—The Skiddaw Granite and its Metamorphism: R. H. Rastall.—The Geological Structure of Southern Rhodesia: F. P. Mennell.

Royal Microscopical Society, at 8.—On the Measurement of Grayson's Ten Band Plate: A. A. C. E. Merlin.—Convenient Form of Stand for Use as a Micro-colorimeter and with Micro-spectroscope: Dr. D. Marshall Ewell.—On the Life-history of the Hessian Fly, with Notes on the Tenby Wheat Midge: F. Enock.

THURSDAY, December 16.

Institution of Electrical Engineers, at 8.—Some Quantitative Measurements in Connection with Radio-telegraphy: Dr. J. A. Fleming, F.R.S.—Efficiency of Short Spark Methods of Generating Electrical Oscillations: Dr. W. H. Eccles and A. J. Makower.

Linnean Society, at 8.—Report on the Crustacea Isopoda and Tanaidacea collected by Mr. C. Crossland in the Sudanese Red Sea: Rev. T. R. R. Stebbing, F.R.S.—Pycnogonida from the Red Sea and Indian Ocean collected by Mr. C. Crossland: Prof. G. H. Carpenter.—On a Collection of Blattidæ preserved in Amber from Prussia: R. Shelford.—Isopoda from the Indian Ocean and British East Africa: Rev. T. R. R. Stebbing, F.R.S.—The Bryozoa from Collections made by Mr. C. Crossland, Part II., Cyclostomata, Ctenostomata, Endoprocta: A. W. Waters.

Institution of Mining and Metallurgy, at 8.

FRIDAY, December 17.

Institution of Mechanical Engineers, at 8.—Mild-steel Tubes in Compression and under Combined Stress: W. Mason.—Compound Stress Experiments: C. A. M. Smith.

Institution of Civil Engineers, at 8.—The Foundation and Construction of Dock Walls: H. T. Tudsbery.

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THURSDAY, DECEMBER 16, 1909.

PALÆOZOIC STRATIGRAPHY.

Traité de Géologie. Vol. ii. Les Périodes géologiques. Fasc. i. By Prof. Émile Haug. Pp. 539–928. (Paris: A. Colin, 1908.) Price 9 francs.

THE first volume of Prof. Haug's treatise on geology was noticed in NATURE last year (vol. lxxviii., p. 123), and we now welcome the first part of the second volume, as it is as suggestive, and will no doubt be as useful, as its predecessor. The first volume deals with historical geology, and its first part describes the geological systems—of which the time equivalents are technically valued as periods—from the beginning of the geological record until the end of the Trias. The book continues Prof. Haug's valuable summaries of recent work, his judicious selection of new significant facts and figures, and it is rich in well-reproduced illustrations. It has the merit of being a very cheap text-book, as, though it includes 392 closely printed pages and twenty-eight excellent plates illustrating rocks, fossils and scenery, its published price is only 9 francs. A feature in the first volume that we remarked with regret was the scanty reference to British work; this volume is a great improvement in that respect, as British geology receives its fair share of attention, though the author must have missed several important recent memoirs or he would not have remarked that Carboniferous palæontology has been for a long time past neglected in this country or inserted the footnote on p. 763. The author does not always select for reference the most valued British results, for he quotes Monian and Arvonian, and omits some later more useful terms.

The Palæozoic he divides into four systems—Cambrian, Silurian, Devonian, and Anthracolitic. He subdivides the Silurian into two subperiods, the Ordovician and Gothlandian, and as he admits that they are independent, both stratigraphically and palæontologically, it may be regretted that he does not accept them as distinct systems; for if the name Gothlandian continues to increase in favour, there is a danger that when the two divisions are accepted as separate systems, the term Silurian will fall altogether into disuse. The Devonian system the author adopts mainly on stratigraphical grounds, as he remarks that the fauna alone is insufficient to justify the distinction, as it is so poor in families special to the period.

The volume begins with an introduction to the principles of stratigraphy, and then describes the geological periods in turn. Prof. Haug explains the gradual recognition of the scientific basis and world-wide value of the divisions between the geological systems, for they are due to movements which affected the world as a whole, and by modifying geography and climate produced simultaneous changes in the contemporary faunas and floras. In his account of each system he begins with the history of its classification and nomenclature; he then gives a list of characteristic genera and some notes on the life of the period, illustrated by numerous well-selected figures, such as Ruedemann's Siphonophora-like colony of graptolites with its float. Then follows a brief summary of the distribution of the system through the world, with especial reference to the types of sediments and the relation of the rocks to the transgressions and retreats of the sea. Finally, he gives a sketch of the climate, zoological provinces, and distribution of ocean and continent in the period.

Prof. Haug divides pre-Cambrian time into only two periods, the Archæan and Algonkian. The term Archæan he uses in the sense defined by its founder Dana; he does not go with those—an increasing number—who subdivide the Archæan into two groups, a lower for the massive basal rocks and an upper for the pre-Algonkian schists. The Algonkian he accepts for the comparatively unaltered pre-Cambrian sediments, such as our Torridon sandstone.

One unorthodox feature in the author's classification is his acceptance of one system, for which he adopts Waagen's name Anthracolitic, to include both the Carboniferous and Permian. The suggestion to unite them has been so often made that it is clear that the evidence on its behalf is weighty. It is true that the invertebrate fauna of the Permian is not by itself sufficient to characterise a special geological system, but the great geographical changes and the important development of the vertebrates are strong arguments in favour of maintaining the Permian as a system. The author practically describes the Carboniferous and Permian apart, and together they would make a system inconveniently large and varied.

In the names of the series into which the systems are divided Prof. Haug attaches great weight to priority; thus he rejects the Mississippian of Prof. H. S. Williams because the name had been employed before in a different sense by Marcou, and he appears to regret that he cannot adopt Missourian, instead of the less convenient Uralian, on the ground that the latter is a year older. But as the author rejects Bernician, owing to its having been less adequately defined than the later term Dinantian of de Lapparent, he fortunately allows some discretion in the selection of names. He, however, appears disposed, as a stratigrapher, to pick up the heavy burden of priority which palæontologists are now preparing to throw off.

The account of each geological system concludes with a sketch of its climate, biological provinces, and geography, and the author's work shows the rapid growth in our knowledge of these interesting sections of the earth's history. He directs attention to the numerous Palæozoic glaciations, now proved, including the Huronian described by Coleman at Cobalt, in Canada, the Cambrian discovered by Howchin in South Australia and by Bailey Willis in central China, the Devonian found at Cape Town by Rogers, and the long-known Upper Palæozoic glacials of India, South Africa, and Australia. He rejects the explanation of the last as due to the shift of the South Pole into the Indian Ocean, and attributes the glaciations that occurred in at least four areas of Gondwanaland to geographical causes. He notices the indications of various Palæozoic deserts, but does not mention the desert theory in connection with the origin of the Old Red Sandstone, which he attributes to formation in a lagoon or in a sea like the Baltic, which had some slight connection with the open ocean. His maps of the distribution of land and water in successive systems are excellent diagrammatic sketches, and those of Europe give the chief facts of its complex history. Prof. Haug is an expert on the geological history of France, and he clearly explains the many important differences between the Armorican region and the Central Plateau; he shows these two areas by different hachures in three out of his four structural maps of Europe, and it is only in that of the Gothlandian (Silurian) that the two regions are shown as sharing the same geological conditions. J. W. G.

SYSTEMATIC BOTANY.

(1) *Illustrations of Cyperaceae.* Prepared under the direction of the late Charles Baron Clarke, F.R.S. 144 plates, with explanation. (London: Williams and Norgate, 1909.) Price 12*s.* 6*d.* net.

(2) *Das Pflanzenreich. Regni Vegetabilis Conspectus.* Edited by A. Engler. 38 Heft, iv, 20. *Cyperaceae-Caricoideae.* By Georg Kükenthal. Pp. 824. (Leipzig: W. Engelmann, 1909.) Price 41.20 marks.

(3) *Das Pflanzenreich. Regni Vegetabilis Conspectus.* Edited by A. Engler. 39 Heft, iv, 83. *Phytolaccaceae.* By Hans Walter. Pp. 154. (Leipzig: W. Engelmann, 1909.) Price 7.80 marks.

(1) "WE hope, Mr Clarke, that you will live a very long time!" Mr. C. B. Clarke was fond of quoting this remark make to him by a well-known botanist, Mr. Henri Baillon, if we remember aright, who appreciated his careful work on the Cyperaceæ, a difficult family of plants, and one of which a good monograph was much needed. Unfortunately, Mr. Clarke did not live to complete the monograph to which he devoted so much time during the last twenty-five years of his life, and in connection with the preparation of which he had visited, or received plants from, most of the important botanical collections. The work was left in manuscript which proved too extensive for immediate publication, and botanists must for the present be satisfied with excerpts of the descriptions of new genera and species, together with a skeleton of the author's arrangement, which have been published in the Kew Bulletin (Additional Series, viii.). For particulars of synonymy and details of geographical distribution, reference must be made to the manuscript which is preserved at Kew. It is to be regretted that it was found impracticable to render accessible by means of publication the full results of the work of so close and careful a student of so difficult a family. It is true, as Mr. Clarke himself was wont to observe when reproached with delay, that much of the work had already been published in the important floras of various parts of the world in connection with which he was invariably laid under contribution for the elaboration of the Cyperaceæ; such, for example, as the "Flora of British India," the "Flora of Tropical Africa," and others; but the *magnum opus* which should correlate the parts and supply a complete account of the family is wanting.

The volume now under review comprises a series of 144 plates prepared by Mr. Clarke to illustrate the monograph, many years ago, when the plan of arrangement had been determined, as well as the representative and typical species of each genus. They have been drawn by various artists—Mr. N. E. Brown, Mr. Charles Fitch, and Miss M. Smith; most have been reproduced by the collotype process, but some by lithography. They are remarkably clear. A characteristic feature is the representation on a large scale of dissections of the spikelets and flowers, with diagrams illustrating arrangement of parts, and enlargements of the fruit—an important diagnostic character in the Cyperaceæ. Facing each plate is an explanatory page of text indicating in many cases the actual specimen from which the drawings were made, such as R. Brown, n. 6020; Burchell, n. 7892. The whole forms an invaluable series of detailed drawings illustrating the floral morphology of the genera and species of Cyperaceæ. Dr. B. D. Jackson, who is responsible for the production of the volume, refers in his preface to the generosity of Miss Clarke, the sister of the author, to which the issue of the plates is due.

(2) Georg Kükenthal has the reputation of a careful worker on the section of Cyperaceæ, a systematic account of which is embodied in this ponderous Heft of the *Pflanzenreich*—the most substantial from the point of view of size that has yet appeared. In the general account which precedes the special descriptive portion, the author refers to the division of the order into subfamilies based on the presumed cymose character of the spike in many of the genera; two subfamilies were at first recognised—Scirpoideæ, with racemose spikelets, and Caricoideæ, in which the spikelets were of a cymose nature. Subsequently, however, the author was led to restrict the Caricoideæ to Carex and a few allied genera, and it is in this restricted sense that the term is employed in the present monograph. As thus limited, the subfamily contains four genera—Schœnoxiphium, a small South African genus of six species, one of which is also represented on the highlands of east tropical Africa; Cobresia, for which the author prefers the more correct to the more familiar spelling, Kobresia (the genus was named by Willdenow in honour of Paul de Cobres); Uncinia, and the huge genus Carex. The author follows Mr. Clarke in including Elyna and Hemicarex in Cobresia, and arranges the twenty-eight species in the four sections suggested by Mr. Clarke. The chief interest of the book, however, is naturally centred in the exhaustive systematic revision of Carex, of which just upon 800 species are recognised. A true estimate of the value of Kükenthal's work on this genus can only be ascertained by experience in its use in the field and in the herbarium; but it is at any rate a great thing to have a carefully elaborated monograph with full specific descriptions and detailed accounts of synonymy and geographical distribution. We have long waited for a successor to Boeckeler's monograph for purposes of arrangement of the species.

(3) The systematic treatment of the order Phytolaccaceæ, by Hans Walter, differs but slightly from that adopted by Bentham and Hooker in the "Genera Plantarum." The three tribes into which the order is there divided—Rivineæ, Euphytolacceæ and Gyrostemoneæ—are here maintained with almost identical limitations. Bentham's genus Stegnosperma, classed in the "Genera Plantarum" as a *genus anomalum*, is regarded by Walter as the type of a distinct subfamily, the order being divided into two subfamilies—Phytolaccoideæ and Stegnospermoideæ, the latter containing the single genus Stegnosperma. There has been considerable difference of opinion as to the limitation of this order, especially in relation to the Ficoideæ, certain genera having been included by different authors in each family. The criterion of one or more than one ovule in the carpel is not a universal one, and the author of the present monograph is convinced that the structure of the inflorescence forms a better means of distinction between the two families. A good proportion of new species is described in the course of the work; thus, of twenty-six species of Phytolacca, seven are here described for the first time.

A. B. R.

THE HAND-LIST OF BIRDS.

A Hand-list of the Genera and Species of Birds. (Nomenclator Avium tum Fossilium tum Viventium.) By R. Bowdler Sharpe. Vol. v. Pp. xx+694. (London: British Museum, Natural History, 1909.) Price 20s.

DR. SHARPE may be assured not only of our own congratulations, but of those of ornithologists in general, on the completion of his heavy task and the issue of the final volume of a work the first of which appeared so long ago as 1899. No one who has not tried it can have any conception of the enormous amount of labour involved in a task of this nature, and when we add that the author estimates the total number of distinguishable forms of birds as close upon 19,000, it will be unnecessary further to emphasise the magnitude of the work just brought to a close.

The value of these five volumes to the working ornithologist—whether we altogether agree or not with the author's view as to the limitations of genera, the multiplication of family groups, and the non-recognition of local races—can scarcely be overestimated, although it must always be borne in mind that the work is meant to be used in connection with the British Museum Catalogue of Birds, to the volumes of which references are given under the headings of the various species. In the case of many species, one or two synonyms are given; and almost the only improvement that we could suggest is that in the case of genera and species where well known names have been changed it would have been better if a larger number of synonyms had been quoted, which could have been done without any increase in the bulk of the volume, as there is a large amount of blank paper.

We are glad to see that in the introduction Dr. Sharpe takes the opportunity of making certain amendments in the arrangement of the "orders" of birds, such emendations being, in our opinion, for the most part a decided improvement on his previous scheme. The most important item in this remodelling is the abolition of Carinatæ and Ratitæ as the two main divisions of existing birds, and the inclusion of the tinamus with the ostriches to form one group distinguished by the structure of the palate from a second group containing all other existing birds. When, however, the author proposes to regard these two groups (Neognathæ and Palæognathæ) as equivalent in rank to the one (Saururæ) containing Archæopteryx, we beg to dissent from his views.

In our notices of at least one of the previous volumes of the "Hand-list" we have directed attention to the want of uniformity in the spelling of geographical names. Unfortunately, the author has not availed himself of the hint, with the result that the "pleasing" variety of orthography is more pronounced in the present issue than in any of its predecessors. We have, for instance, Malay Peninsula and Malayan Peninsula on the some page (62), and Malacca in another place; Dentrecasteaux (p. 63) and D'Entrecasteaux (p. 69); Niasa-land (p. 47), Nyasaland (p. 35), and Nyasa Land (p. 474); Cashmere (p. 167) and Kashmir (p. 173); Szechuen (p. 233) and Szechuan (p. 268); Somali-land (p. 184) and Somali Land (p. 465); Damara-land (p. 185) and Damara Land (p. 475); and Island of St. Thomas in one place (p. 463) and S. Thomè Isl. in another (p. 635). We may also note (p. 175) Lipikia for Likipia. In our own experience, the only way to avoid discrepancies of the above nature is to enter every name as it occurs in a list, and to check all subsequent occurrences. With the exception of these discrepancies, which are creditable neither to the author nor to the museum, we have little except commendation to bestow on the volume before us.

For reference purposes, the whole work suffers, however, from the circumstance that the page-headings on both sides are taken up by useless repetitions of the general title, whereas the heading on one side should have carried the family-names. In the case of large families, to find the family-position of a genus it is necessary, after ascertaining the page on which it occurs from the index, to turn back until the family-name is reached, or to refer to the table of contents. In this respect the work compares badly with the "Catalogue of Birds' Eggs." A general index to the five volumes would also have been very useful.

R. L.

SOCIAL EVOLUTION.

Darwinism and Modern Socialism. By F. W. Headley. Pp. xv+342. (London: Methuen and Co., 1909.) Price 5s. net.

MR. HEADLEY has given the general reader a comprehensive and well-stated case against Socialism. He brings together the best of the known economic arguments, and bases the whole on biological principles.

The text is that "it is very difficult for a follower of Darwin and Weismann to be a Socialist." In a survey of early forms of mutual dependence, such as the village community in England and India and the Russian *mir*, he shows that the Socialism, so-called, of the primitive and pre-industrial epochs did not conflict with Darwinian principles. The new Socialism, however, aims at stopping "the struggle for existence" and the elimination of "the unfit."

Much stress is laid all through on the institution of the family, which is a permanent possibility of individualism, and the eternal matrix of capitalism.

The author's view is clear; he avoids irrelevancy, and has the faculty of going straight for the point and of illustrating it by well-chosen examples. Thus he shows that "natural selection" acts only at crises, such as disease or war. In an excellent analysis of the work of our Post Office he emphasises the only relevant points, namely, that all Government departments are wasteful, and that success is really the result of "private" enterprise and of "private" criticism. The same truths apply to "the common sense of municipal trading," a curious hybrid between Socialism and Capitalism. The proofs of all this are well put.

"To abolish private industry would be to kill the goose that lays the golden eggs"; and this is what the Socialist proposes to do. The two chapters which demonstrate this are excellent, and the author has humour as well as insight.

The main defect of our economic system (to which is ascribed the vigour of theoretical Socialism) is excessive accumulation of capital. The main duty of the State is to act as umpire in the competitive struggle. It must not itself produce.

As to minor points calling for criticism, the explanation of the custom of a mock "capture" of the bride as a survival of "bride-lifting" from another tribe is obsolete. Such ceremonies have a psychological origin. The bride is "captured" from her sex and herself.

The frequent objection of Socialists to Christianity is hardly due to a desire to abolish the family. It is rather due to its claim of "authority" and its tendency to Erastianism.

Yet about this book, as about previous applications of "natural selection" to human society, there is something unsatisfactory. False analogy and ambiguity of terms may result, if we forget the fact that in a civilised community survival largely depends on factors which do not exist in "nature."

This doubt may be applied by the reader to chapter ix., the most crucial and the least convincing. It is on "natural selection among civilised peoples."

There is something wrong about the identification of the struggle for existence in the natural world with our competitive system. Transfer a typical unemployed to a state of nature and he would survive. The conditions of the two cases are so different.

Then what is survival-merit now? Mr. Headley speaks of steadiness, honesty, and thrift. An impartial view must add unscrupulousness, low cunning, incapacity for generosity, mercy, and the nobler ideals, for art and culture, and—for conscientious work. Moral values are, of course, a matter of time and place, but there is such a thing as dehumanisation. Add physical survival-merit, and consider if we are not evolving a type which has been described as "a race of men, small, ill-formed, disease-stricken, hard to kill."

He speaks of our lowest class as living in a "primitive" fashion. By its "best blood" the next stratum is reinvigorated. Here is ambiguity of terms.

The selection going on under our competitive system is not necessarily producing "the splendid pattern" of which Mr. Headley and the poet have dreamt.

A. E. CRAWLEY.

A HERO OF MEDICINE.

Semmelweis: his Life and Doctrine. By Sir William J. Sinclair. Pp. x+369. (Manchester: University Press, 1909.) Price 7*s.* 6*d.* net.

"IN the history of midwifery there is a dark page, and it is headed Semmelweis." Semmelweis was a prophet, and he was misunderstood by the people he came to save. The services he rendered mankind cannot be overestimated. His discovery was epoch-making. He established the cause of puerperal fever, and threw light on all septic conditions. Before his time the cause of wound infection was not understood. Semmelweis proved that puerperal fever was analogous to wound fever, both being due to contamination from putrid organic matter. The cause of puerperal fever having been established, Semmelweis worked at its prophylaxis. He insisted on the cleanliness of the patient and her surroundings, and sketched the principles which underlie the antiseptic and aseptic treatment of wounds, and so laid the foundation for modern surgery, gynæcology, and obstetrics. During his life Semmelweis was misunderstood and misrepresented; he met with opposition, jealousy, and hatred from his own profession; he was degraded and belittled; yet, to-day, his conclusions are universally accepted and form the foundation of surgical thought.

There should be a wide public, lay as well as medical, for a book as full of historical, scientific and human interest as this "Life of Semmelweis." It is a just tribute to the memory of a very great man. The only criticism which might be made is that the last hundred pages, dealing with discredited contemporary opinions, might have been curtailed. The early chapters give a vivid account of the conditions under which Semmelweis worked as student and assistant in the great lying-in hospital of Vienna. His attention was soon arrested and his heart wrung by the appalling death-rate among the patients, and he resolved to find the cause of the scourge which decimated the hospital. Broadly, the facts were these: the mortality among women delivered in the hospital, always higher than that among those confined at home, suddenly rose to an unprecedented figure in the year 1822, when the anatomical basis of instruction was introduced into the curriculum of the medical students. The students used to pass from the dissecting-room to the labour wards, and from this time the hospital mortality rose until at one period nearly half the patients died. The lying-in hospital consisted of two divisions similar in every respect, except that in the first division the women were attended by the students and in the second division by midwives. Semmelweis found, over a period of five years, that the mortality in the first division remained three times as high as that in the second. What was the cause of this? A significant entry occurs in his note-book:—"All is doubt and difficulty. Only the great number of the dead is an undoubted reality."

In 1847 Semmelweis's friend Prof. Kolletschka died of septicæmia from a scratch on the finger received at a *post-mortem* examination. The circumstances of this tragedy, its origin from the introduction of a poison into a wound surface, the course of the illness, and the pathological results revealed by examination of the body after death brought illumination to Semmelweis. This was a similar condition to the "fever" of puerperal women; both were due to inoculation of putrid organic matter, hence the terrible mortality among women attended by students fresh from the mortuary and the better results obtained by the midwives. In 1847 "the eternally true doctrine" was announced, but no wide publicity was given to it, and it failed to obtain general acceptance. Had Semmelweis been a ready speaker or writer, had his personality been different, more ambitious, perhaps even more winning, the great truth might have been accepted by the profession. Instead of this he died unrecognised, after years of embittering and acrimonious discussion. Sir William Sinclair's book is of the greatest interest, and we are glad to welcome an adequate English appreciation of Semmelweis, who certainly ranks among the "heroes of medicine."

NON-EUCLIDEAN GEOMETRY.

The Elements of Non-Euclidean Geometry. By Dr. J. L. Coolidge. Pp. 292. (Oxford: Clarendon Press, 1909.) Price 15*s.* net.

THIS work will be found really valuable by all students of geometry, especially by those who know little or nothing of the non-Euclidean theories. First of all we have a discussion of the elementary axioms; in this the plane is deduced from what may be called a triangular frame, in the manner of Peano and Schur. Then comes the discrimination of the three cases, according as the sum of the angles of a plane triangle is equal to, greater than, or less than two right angles; and this is followed by the fundamental trigonometric formulæ for a triangle, deduced very neatly from Saccheri's isosceles birectangular quadrilateral. It is also proved at this stage that the non-Euclidean plane can be developed upon a surface of constant curvature in Euclidean space.

The author next proceeds to a discussion of higher spaces (in three dimensions), the absolute, and groups of congruent transformations. The treatment here is entirely analytical, and for the beginner, at any rate, this is doubtless the proper course to take. In fact, most will feel that the analytical treatment of the subject has the great advantage of preserving us from fallacies and vicious circles.

The next chapters contain developments relating to curves and surfaces of the first and second orders; in particular, there is an interesting chapter on the higher line-geometry. In some respects this is analogous to Staudt's representation of an imaginary line of the second kind; but it should be said that there is only a very brief sketch (pp. 127–30) of the interpretation of imaginary coordinates in non-Euclidean space.

The chapter on areas and volumes is remarkably good and clear. The formula for the area of a triangle is obtained by a method which is both elementary and rigorous; and there is a very interesting discussion of the volume of a tetrahedron.

Chapters xv. and xvi. are on differential geometry, and here again the treatment is admirable. For one thing, the quantities usually denoted by D, D', D'' present themselves in a natural way instead of resulting from a long and tedious calculation. Among the prettiest results of these chapters are the extensions of Meunier's theorem and of Gauss's theorem on the total curvature at any point on a surface.

There is a brief discussion of multiply connected spaces, and two final chapters, each of which is, in fact, an independent presentation of the subject, one from the projective point of view, and the other, like that of Riemann's famous essay, based on the properties of a quadratic differential form. The reader cannot fail to profit from these various ways of regarding the subject; their agreement in results will help to free him from the natural prejudice which many entertain—that non-Euclidean geometry is a mere juggling with symbols, having no relation to the properties of space as it actually is. After the recent critical work on the foundations of geometry, the conclusion is inevitable that there are no grounds at present, and probably never will be, for asserting that the space of physical phenomena is Euclidean or non-Euclidean; while in the realm of speculation the three kinds of space are coordinate, and equally possible.

G. B. M.

COLOUR PHOTOGRAPHY.

Über Farbenphotographie und verwandte naturwissenschaftliche Fragen. By Prof. Otto Wiener. Pp. 88. (Leipzig: J. A. Barth, 1909.) Price 2.40 marks.

THERE is, perhaps, no more remarkable recent scientific achievement than the realisation of the problem of photography in colours, which has occupied the thoughts and aspirations of many workers since the day when Nicéphore Niépce, the founder of photography, told the Marquis de Jouffroy that one day he would reproduce his likeness just as he saw it in a mirror.

In this reprint of a discourse on colour photography and kindred physiological questions, delivered at the Congress of Naturalists in Cologne in September, 1908, Dr. Otto Wiener has given a brief sketch of the principles of the various methods of colour photography, with additions, chiefly of omissions from the discourse itself, together with copious notes and references to the literature, and further details of the subject, and the biological side of the question as regards colour mimicry in animals. It is illustrated with three plates in colours.

The author first discusses the nature of white light, its decomposition and recomposition, the nature of the colours shown by coloured objects, pigments, dyes, &c., and their effects on the reflection, absorption, and transmission of white light, with special reference to the coloured glasses to be used as filters in three-colour photography. Then the various processes by Ducos du Hauron, Ives, Sanger Shepherd, Joly, Miethe, Lumière, and others for producing coloured photographs by the additive and subtractive methods of colour mixtures, dependent on the theory of triple-colour sensations enounced by Young, Helmholtz, and Clerk Maxwell.

The discussion of the Becquerel and Lippmann direct methods of colour photography, founded on Zenker's theory (1868) of interference and stationary waves producing an alteration of the structure of the sensitive film by reflection, corresponding to the wavelength of the light acting on it, is interesting, because of the author's confirmation of the theory in 1890, and its practical adaptation by Lippmann in 1891. The other direct methods, dependent on changes of colour in sensitive films of silver chloride and subchloride, discovered by Seebeck and worked out by Becquerel, Poitevin, and Niépce de St. Victor, also the "bleach-out" methods of Worel, Neuhauss, Smith, and others are explained. After a short notice of the theories of colour perception, the discourse concludes with some very interesting remarks regarding the protective colour adaptation of animals, and the researches of Poulton, Standfüss, Weismann, Herbert Spencer, and others, illustrated by a coloured plate showing protective mimicry in insects.

Though the subject is dealt with briefly and theoretically, the book will be useful as a summary of results already achieved, and particularly for the literary and other information given in the notes. We note one omission in the list of books at p. 49—Dr. H. W. Vogel's "Die Photographie farbige Gegenstände," 1885. Those interested will find further information in Prof. Wiener's papers in *Wiedemann's Annalen*, xxxi., 1887, p. 619; xl., 1890, p. 203; lv., 1895, p. 225; and Eder's "Jahrbuch für Photographie," 1896, p. 55.

J. W.

OUR BOOK SHELF.

Outlines of Chemistry, with Practical Work. By Dr. H. J. H. Fenton, F.R.S. First part. Pp. xvi + 365. (Cambridge: The University Press, 1909.) Price 9*s.* net.

THIS book embodies the substance of a course, or part of a course, of lectures which the author gives to candidates for the Natural Science Tripos at Cambridge. Supplemented in practice by experiments appropriate to the topics of each lecture, it is intended to give the student a lead to the study of standard chemical literature. Mr. Fenton explains the difficulty of the circumstances under which the teaching has to be done, and he appears rather as one who has to comply with an established system than the exponent of a system that he thinks the best, or even very good. No one, of any modesty, who is engaged in teaching chemistry to university students at the present day will be very dogmatic about the details of the course that should be followed. The subject has become so vast and so varied that personal predilections and capacities may lead to courses very different from one another and yet of no very different merit. Two extremes may be found in the tendency of one kind of teacher to produce a chemist well informed about substances and another kind to produce a chemist well informed about principles; the first would ordinarily be the better craftsman, the second the clearer thinker.

The tendency of the Cambridge Tripos system is not unnaturally towards making chemistry as much like physics as possible, and accordingly the Tripos candidates are led to concern themselves with theoretical and physical chemistry to an extent which seriously limits their chances of acquiring that personal familiarity and facility with individual chemical substances which in earlier days was one good outcome of the *régime* of analysis. It leads also to a subordination of chemistry in relation to industrial and practical problems. It is possible that some readjustment might be worth considering, having regard to the increasing importance of the Cambridge school and especially to the influence which Cambridge graduates exercise in the secondary schools.

However this may be, Mr. Fenton, on the lines he had adopted, has written a book that must be rated very highly. It is marked throughout by the lucidity and scientific restraint to which we have been accustomed in all his writings; it is very thorough and comprehensive, and it shows a real grasp of the inwardness of a good many things about which there has been a good deal of loose writing and, presumably, loose thinking. It is a book that may be read with profit by every student of chemistry at some stage of his career—perhaps for most at some late stage, when reviews are so valuable, especially if they are free from special pleading. As an example of the excellent substance and form of the book, the chapters on acids, bases and salts may be specially cited, but there is, in fact, little departure from a high level of exposition throughout the work. It seems very likely that the second volume, which is promised, should the first prove acceptable, will be clearly called for.

A. SMITHELLS.

The Kea: a New Zealand Problem. By G. R. Marriner. Pp. 151. (London: Williams and Norgate, 1909.) Price 7*s.* 6*d.* net.

FEW birds have attained to greater notoriety than the New Zealand kea, and every naturalist has long been familiar with the strange story of its sheep-killing propensities. The change of habit which it is supposed to have undergone since the introduction of sheep into New Zealand has formed the subject of much discussion by writers on evolution, but it appears that a great deal of theorising has been based upon a singularly small amount of trustworthy evidence. Serious doubt having been cast upon the generally accepted stories, Mr. G. R. Marriner, the curator of the public museum at Wanganui, set himself the task of collecting all the evidence available and personally investigating the habits of this remarkable bird, and the results of his inquiry have been published in a very valuable and readable book. The case has been fairly tried, and the kea stands condemned on abundant evidence. The executioners have long been at work. They did not think it necessary to wait for the result of the trial, and the large sums of blood-money paid for kea heads must have done a good deal to keep the birds in check, though their haunts in the remote mountain regions of the South Island are often so inaccessible that it may well be doubted whether they will ever be exterminated. Those who love bird-life better than mutton will probably hope not.

The natural food of this extraordinary parrot consists of fruits, roots, honey, worms, insects, and grubs. It is gifted with an inordinate curiosity, and seems ever ready to experiment and investigate novelties. Mr. Marriner believes that this inquiring spirit is responsible for its predilection for fresh meat; that it first began by experimenting with sheepskins and dead carcases, and later on took to killing on its own account. The idea that the kidneys are its especial tit-bits seems to be based entirely upon the fact that the sheep is generally attacked in their neighbourhood; this, however, is the only part upon which the kea can maintain a footing while the sheep is racing about and trying to throw off its torturer. The cruelty of the whole proceeding is horrible in the extreme, and the annual loss to the run-holders is estimated by the author at 5 per cent. of the flocks. The birds appear to enjoy their sport exceedingly, but they have not yet learnt wisdom, and fall an easy prey to the avenger. When the kea hunter has exhausted his cartridges, he sometimes, we are told, allows the birds to see him disappear behind an overhanging ledge of rock. Their curiosity induces them to try and find out what has become of him, and one by one they walk to the edge and look over, only to be knocked on the head by his stick. If so, why waste cartridges? Perhaps there is not always a suitable rock handy.

The book is brightly written, and contains some good illustrations, and we recommend it to all lovers of nature. Considering its size, however, the price seems to be rather high. A. D.

(1) *How to Study the Stars.* By L. Rudaux; translated by Dr. A. H. Keane. Pp. 360. (London: T. Fisher Unwin, 1909.) Price 5*s.* net.

(2) *How to Identify the Stars.* By Dr. Willis I. Milham. Pp. v+38+plates. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 3*s.* net.

(1) Both the means and methods of observation dealt with in this book are eminently practical, being founded for the greater part on the progressive astronomical equipment of the author and the methods which, in actual use, he has found effective. The needs of the amateur are all along kept in mind. The interested and intelligent user of a pair of opera glasses is led to make for himself apparatus more ambitious. As the possessor of a telescope he is shown practical, and often home-made, mountings for the smaller sizes, while for the amateur of means, to whom a medium-sized equatorial reflector or refractor is possible, the question of a suitable house for his instrument is dealt with. Here the varied experience of the author is called in, the important question of cost not being forgotten.

Part ii. is concerned mainly with methods of observation and results. The study of sun, moon, and planets is undertaken, often with apparatus by no means extravagant, and the kind of results which may be expected are indicated, by reference to the author's own work, and by actual photographs reproduced.

For the purpose of progressively instructing amateur astronomers, the book should prove successful. The translation seems, on the whole, well done, and a readable work has been produced.

(2) The title of this book suggests at once its elementary nature. The appeal both of the text and the charts is to beginners in astronomy. The thirty-eight pages of letterpress deal in a sketchy way with such subjects as the history of the constellations, stellar magnitudes, and colours and methods of study. So many subjects in so few pages obviously precludes any fulness of treatment. The "history" consists chiefly of a list of constellation names, with genitives and meanings, together with the names of their proposers, and the section devoted to "star colours" occupies less than a page. The list of the twenty brightest stars, giving magnitudes and colours, is useful, while the division of the eighty-eight constellations into four distinctive groups should prove helpful in memorising.

Four small charts, showing the stars visible at convenient hours during the various months of the year, and twenty-four constellation tracings are appended.

An excellent feature of the publication is the list, at the end of each section, of books and papers suggested for further study.

The general method followed and material presented is stated to be essentially the same as that used in the course on descriptive astronomy in Williams College. Within its limitations the work is accurate and serviceable, and may be recommended as a convenient epitome of the subject.

Scientific Nutrition Simplified. By Goodwin Brown With a Supplementary Chapter by Dr. J. Sven. Pp. xi+271. (London: William Heinemann, 1909.) Price 2*s.* 6*d.* net.

This little book is one of the simple-life series. It puts in popular language the information for the practical application of the principles of nutrition advanced by Mr. Horace Fletcher and Prof. Chittenden. The main principle involved is the reduction of the protein intake to about half the amount usually accepted by physiologists as the normal. In reviews of similar books which the present writer has contributed to Nature during the last few years, it has been pointed out that the Chittenden *régime* is not free from danger, and it is unnecessary to traverse the same ground again. The general tenor of the present work contrasts very forcibly with the scientific exposition of the subject in the work of Max Rubner recently reviewed (November 4, p. 2). The enthusiast sees only the *pros* and does not pause to consider the *cons.* in a subject which really bristles with difficulties. No one wishes to advocate over-eating, but to preach a doctrine of under-feeding as a permanent and universal practice is a very different thing from the temperance and moderation which is the ideal. The majority of physiologists have condemned the Chittenden diet as insufficient, and those with knowledge are more likely to be correct than the faddists, even if they can count one or two disciples drawn from the scientific world in their ranks.

A great point is made in the present work of Mr. Fletcher's advocacy of thorough mastication. Nobody denies the importance of the saliva and of the process of chewing, but to advocate the supreme importance of the least important of the digestive juices, and to elevate the action of the jaws into what seems to be regarded almost as a religious exercise, is not only unscientific, but ridiculous. W. D. H.

A Barometer Manual for the Use of Seamen; with an Appendix on the Thermometer, Hygrometer, and Hydrometer. Issued by the authority of the Meteorological Committee. Sixth edition, extensively revised. Pp. 67. (London: H.M. Stationery Office, 1909.) Price 3*d.*

Although chiefly intended for the use of seamen, this manual will be found of much service by anyone desirous of obtaining accurate information relating to the use of the barometer, and its connection with weather conditions and storms experienced in all parts of the globe. It is a revised edition of the Barometer Manual prepared by the late Admiral FitzRoy, formerly chief of the Meteorological Department of the Board of Trade, which was very favourably received. The popularity of the present manual and its immediate precursors has been greatly increased by its adoption by the Board of Trade as a text-book in connection with the examination of masters and mates in the mercantile marine service. It has been prepared under the superintendence of Commander Hepworth, marine superintendent of the Meteorological Office, formerly a keen observer of meteorological phenomena in various oceans. Several new charts have been constructed from the materials in the possession of the meteorological committee, and show, *inter alia*, the mean isobars for the middle months of each quarter, and the pressure and prevailing winds for January and July over the globe, with an interesting discussion of the leading features exhibited.

Cows, Cow-houses, and Milk. By G. Mayall. Pp. xi+102. (London: Baillière, Tindall and Cox, 1909.) Price 2*s*. 6*d*. net.

The above title covers a lot of ground for a small book of about a hundred pages. Naturally, we expect to find the information much condensed; thus, in the chapter on breeds, little more than a page is given to the premier race, Shorthorns. Again, in feeding cattle and in the variations of milk, we are told, in the one case, a fair ratio is 1 to 6 or 7, and, in another place, ½ lb. to ¾ lb. of good oats is said "to improve fat yield and milk taste." We should have preferred to have seen the starch equivalent and protein in the ration explained in a different way. Breeders, like other people, cannot be expected to agree on all points, and we should wish to have our heifers served long before "at the end of their second year."

The illustrations are very good, and misprints in the reading matter appear to be very few. One may be pointed out on p. 56, concerning the average per cent. of fat in cream, which may be anything from 25 per cent. upwards; also, on p. 63, 40° C. should read 40° F. Of the hygiene and veterinary sections we have nothing but unstinted praise. Everyone interested in this important subject should read "Checking the Spread of Disease." The book can be commended to the improving landowner, the land agent, the dairy farmer, and the short-course student, who requires much information in a limited time.

The Oxford Geographies. (Oxford: Clarendon Press, 1909.) *The Elementary Geography.* By F. D. Herbertson. Vol. II., *In and About our Islands.* Pp. 112. Price 1*s*. Vol. IV., *Asia.* Pp. 128. Price 1*s*. 6*d*. Vol. VII. *The British Isles.* Pp. vi+192. Price 1*s*. 9*d*.

Cambridge County Geographies. Gloucestershire. By Herbert A. Evans. Pp. x+155. *Westmorland.* By Dr. J. E. Marr, F.R.S. Pp. ix+151. (Cambridge: University Press, 1909.) Price 1*s*. 6*d*. each.

The characteristics of the series of elementary books of geography to which the new volumes under notice belong have been described already in these columns (vol. lxxxii., p. 125). In the three new parts of Mrs. Herbertson's "Elementary Geography," it is satisfactory to find the same simplicity of language, correctness of information, and abundance of well-chosen illustrations which served to make the earlier volumes admirably adapted to the requirements of junior classes.

Both Mr. Evans and Dr. Marr have entered into the spirit of the scheme of the Cambridge County Geographies, and their accounts of Gloucestershire and Westmorland respectively maintain the high standard of the series. Geography is given the same wide interpretation, and the books include a description of the architecture, natural history, and geology of the counties dealt with.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Atomic Weight of the Radium Emanation.

In a paper by Mr. A. J. Berry and myself read before the Royal Society on December 9, on the thermal conductivities of gases at very low pressures, we showed that for the heavier monatomic gases, neon and argon, the experimental conductivity agreed (as well as could be expected from the present state of the measurements) with that calculated from the kinetic theory from the number of impacts of the molecules per sq. cm. per second and the molecular heat of the gas, assuming perfect interchange of energy on impact.

This suggests a possible means of obtaining experimental evidence on the much-debated question of the atomic weight of the radium emanation. If a moderate fraction of a gram of radium were available the infinitesimal quantity of the emanation would not be an insuperable difficulty, for at the sufficient pressure of 0·04 mm. the emanation from this quantity would occupy the sufficient volume of 2·2 c.c. The pressure of the emanation could be deduced from existing data by means of γ-ray measurements; but also, with hardly any elaboration of the apparatus, an accurate determination of the volume of the emanation could be obtained. For it may be remarked, without in any way reflecting upon the numerous and careful experiments that have been done on this volume since its first determination six years ago by Sir William Ramsay and myself, the purification of the emanation by ordinary methods appears at the best to be imperfect; whereas to an operator experienced in the use of the calcium method, worked out in this laboratory, no difficulty is to be anticipated.

On the view discussed in our paper, the thermal conductivities of the heavier monatomic gases should be inversely proportional to the square root of their atomic weights, so that the atomic weight of the radium emanation could be compared with those of the heavier argon gases by a novel method.

Frederick Soddy.

Physical Chemistry Laboratory, University of Glasgow.

Alkali-syenites in Ayrshire.

It is now well known that a group of basic alkalic rocks of approximately late Carboniferous or early Permian age occurs in central Scotland. Dr. Teall first remarked the teschenitic affinities of some of these rocks in his "British Petrography" (1888). During the recent work of the Geological Survey in central Scotland, many occurrences of teschenite, essexite, and theralite have been recognised by Mr. Bailey and Dr. Flett. In several localities the teschenites pass into picrites of the Inchcolm type. Although the general facies of this group is quite basic, and locally ultra-basic, the presence of acid veins in some of the teschenite intrusions has encouraged the hope that a more acidic phase might be discovered in some of the lesser known intrusive masses of central Scotland, hitherto indiscriminately lumped together as "dolerites."

This hope has been realised by the discovery of a large mass of alkali-syenite at Howford Bridge, near Mauchline. This mass, which is intrusive into the Permian lavas of the central Ayrshire basin, is finely dissected by the river Ayr. It is composed mainly of a peculiar medium-grained rock, consisting of thoroughly idiomorphic felspars, principally anorthoclase, with subordinate albite and orthoclase, a little nepheline, numerous small crystals of ægirine, brown and bluish-green soda-amphiboles (barkevicite and arfvedsonite) in mutual intergrowth, and ilmenite altering to leucoxene. The well-shaped crystals of felspars are loosely crowded together, and the angular spaces between them filled with abundant fresh analcite, which encloses the ægirine and soda-amphibole, as though these had been pushed aside by the crystallisation of the felspars in a thoroughly liquid magma. This rock passes downward into a teschenite by the incoming of purple titanaugite and basic soda-lime felspars, but the latter rock is penetrated by irregular veins of the analcite-syenite.

This occurrence is interesting, inasmuch as there is only one other occurrence of alkali-syenites in the British area, namely, the borolanite and associated syenites of Sutherlandshire. These, however, are probably of Cambrian age. The Ayrshire occurrences are being investigated by the writer with the aid of a Royal Society grant, and it is hoped that an account of these alkalic rocks will be published in a short time.

G. W. Tyrrell.

University of Glasgow, December 9.

Collected Works of Sir William Herschel.

I beg to direct attention to a pressing need, namely, the publication of the collected works of Sir William Herschel. The investigations of this great man are practically inaccessible to the vast majority of modern astronomers, and the result is that few have any acquaintance with his writings, or know them only second-hand. In my relations with American astronomers I have met no one who has made a close study of Herschel's papers, and in going over them myself have been obliged to obtain them from distant libraries and abstract the contents by laborious processes. I have been equally impressed with the deep insight into the laws of nature which Herschel shows, and the slight extent to which his conclusions and methods are known to modern workers. Surely you will be willing to lend your voice to the praiseworthy task of awakening the British public to a national duty. When writing the life of Herschel for the "Encyclopædia Britannica" thirty years ago, the late Prof. Pritchard directed attention to the necessity of the publication of Herschel's collected works; but meanwhile nothing has been done. Italy has published the collected works of Galileo, Holland the collected works of Huyghens, while France has published the collected works of several of her great mathematicians and astronomers, &c., as those of Lagrange, Laplace, Fourier, Fermat, &c., and now the Swiss, with commendable effort, are trying to publish the vast collected works of Euler.

Herschel's writings are not very voluminous, and probably could be comprised in one large or two moderate sized volumes; and it seems certain that a thousand copies of them could be sold within reasonable time, so that a good publishing house might safely undertake the risk; but in order to give the work a national stamp it would need supervision by an official committee of the Royal Society, or the Royal Astronomical Society, of which Herschel was the first president.

T. J. J. See.

U.S. Naval Observatory, Mare Island, California,
November 20.

An International Map of the World.

I have read with much interest, in Nature of December 2, the communication by Sir Duncan Johnston. I must, however, confess that two of his propositions tend to damage the very principle of uniformity aimed at by the original idea.

For if, in the preparation of the map of closely populated districts, another scale (in the details) is to be adopted, the general idea conveyed by the map will be misleading.

The same is the case with altitudes. It is necessary to take into consideration the fact that, in all probability, the metre-unit will be adopted throughout the world in the time necessary for the preparation and issuing of the proposed maps. In the meantime, it should be noted on the sheets for foot-countries: 1m. = 3 feet.

E. Báthori.

Nagybecskerek, Hungary, December 6.

With reference to Dr. Báthori's letter on the article which appeared in Nature of December 2, on the 1/1,000,000 scale international map, I agree with him to the extent that I am fully impressed with the importance of uniformity so far as it can be attained without detriment to the value of the map, but I consider that in some cases uniformity can only be obtained at too great a price.

Dr. Báthori demurs to my suggestion that the detail shown should not be absolutely uniform throughout the world. I can best illustrate my view that too hard and fast a uniformity should not be insisted on by stating a concrete case. The committee proposes, and I think rightly, to show on the map lines of telegraph and post offices. In sparsely settled countries, for example Rhodesia, such information would be useful, and could easily be shown on the map. In the populous London district such information would be of no value, even if it could be shown, and I think that the practical utility of the map would be increased in this case by some departure from strict uniformity. Other similar cases might be given.

With regard to the other point mentioned by Dr. Báthori I am afraid I cannot agree with him that the metre will be adopted throughout the world, and I certainly hope that the completion of the international map will not be postponed until the metre is generally used. In the past and the present the foot has been and is used as the unit of measurement in the United States of America, in Great Britain and Ireland and its colonies and dependencies; practically all records are in terms of that unit, and it must be many years before this unit can be changed, if it ever is. If the countries named do not exceed in area and population those which have adopted metrical measurements, they are, at any rate, large enough to merit consideration. I see no reason why the altitudes in this very large and populous area should be shown on the map in terms of a unit not generally used by their people, nor, on the other hand, do I see any cause why the large and populous countries which have adopted the metrical system should have their altitudes expressed in feet.

It seems to me that, provided the unit adopted is legibly marked on the map and subject to some give and take where the two systems meet, countries using the foot should have their altitudes expressed in feet, and those using the metre in metres. I do not think this would cause material difficulty. The practical advantages of this course seem to me to justify some departure from rigid uniformity.

Duncan A. Johnston.

Eastbourne, December 10.

Positions of Birds' Nests in Hedges.

During the autumn and winter of the past three years I have been observing the distribution of birds' nests as regards position in the hedges. In the fields around this village the following facts are noticed. In hedges running north and south (facing east and west), by far the greater number of nests are found to the east of a line through the length of the hedge. In hedges running east and west (facing north and south), very few are on the north side, some in the centre, but most to the south of the line through the length of the hedge. There seems to be a very good reason why this should be the case, but it would not do to state reasons without more evidence. I have not seen this matter noticed in any book or "paper," and it would be interesting to know how the majority of the nests in other parts of the country are placed. The present is a good time for such observations.

J. H. Tull Walsh.

St. Faith's, Norfolk, December 2.

Uranium Ore as a Remedy.

With reference to Mr. H. Warth's letter in Nature of November 11 (p. 38), it may be of interest to record a fact which has come under my notice while engaged in the development of a uranious mine in Turkestan. The ore is oxidised and calcareous, and contains uranium, vanadium, and copper, radium being present in accordance with Prof. Rutherford's formula, which gives the quantity of it in relation to the uranium. The uranium is on the average 3·8 per cent., but in some places reaches the ratio of 30 per cent. and more. Until now the work in the mine has proceeded only in the summer time, and in the winter season the workmen have migrated to the neighbouring coal and copper mines. As I know from the literature of the subject that vanadium and uranium are toxic substances, I instruct the workmen to wash their hands well before going to their dinner and after their work. "We do this," they say, "but at the same time we know that in actual practice a cut on a hand, which lasts for a long time in a coal mine, here, when powdered by the ore, gets well very quickly."

CHR. ANTOONOVICH.

St. Petersburg, Russia, M. Possadskaya 21,
December 4.

Lunar Rainbow of December 1.

ON Wednesday, December 1, about 11 p.m., we saw here a very fine lunar rainbow. It was a perfect bow in the west, showing on a black sky. At the two ends the colours of the rainbow were to be seen quite plainly, though there was only about half a moon. Had there been a full moon, the sight would have been very fine. The rainbow was visible for about twenty minutes.

RICHENDA CHRISTY.

Orchards, Broomfield, Chelmsford.

THE TERCENTENARY OF THE TELESCOPE.

THE year 1609 is one of the most remarkable epochs in the history of astronomy. In the summer of that year Kepler's book on the motion of Mars was published, in which for the first time the actual orbit of a planet in space was determined, while astronomers had hitherto only been able, with more or less success, to investigate the projection of that orbit on the celestial sphere. In the same year the newly-invented telescope was directed to the heavenly bodies, and enabled mankind to form an idea of their constitution, instead of being, as hitherto, reduced to making wild guesses on this subject. But while many years had to pass before Kepler's work became generally recognised (even Galileo never accepted it), the telescope at once became an indispensable tool to astronomers.

Though many attempts have been made to prove that some of the ancient or mediæval philosophers made use of telescopes, it is now generally acknowledged that the telescope was not known to anyone before the year 1608.[1] On October 2 of that year Johan Lipperhey, a spectacle-maker of Middelburg, submitted to the States General an instrument for seeing at a distance, which he had invented, "as was known to the members of the States," and demanded either a patent for thirty years or an annual pension. The States General desired the inventor to produce a binocular telescope, and when he did that they eventually paid him 900 florins for three instruments of this kind, while the patent was refused on the plea that the invention had already become known to many people. These facts are certain enough, but it is quite possible that Lipperhey may not have been the first to construct telescopes, but that the claims of Zacharias Janssen, another spectacle-maker of Middelburg, may be well founded. It appears that this man had invented a compound microscope in 1590. A story was current early in the seventeenth century that some children, when playing with lenses, had found that a weathercock viewed through two of them appeared much enlarged and turned upside down, and that this led to the invention of the telescope. But a telescope which produces an inverted image must have been the so-called astronomical telescope soon afterwards invented by Kepler, which has a convex eye-lens, and not the Dutch or Galilean telescope with a concave eye-lens of which the modern opera-glass may serve as a specimen. A man who had invented a compound microscope would not be unlikely to possess lenses good enough to produce a fair image of a weathercock, and to have been capable of modifying this accidental discovery by substituting a concave eye-lens to make the image upright. Some person is said to have gone to Middelburg to procure a telescope from the spectacle-maker there, but to have applied, by a mistake, to Lipperhey, who thus first heard of the invention.

Whether Lipperhey or Zacharias Janssen was the first to make telescopes will probably never be settled with absolute certainty, but in any case the first telescopes were undoubtedly made in Middelburg. In the introduction to the catalogue of his library (p. xviii), Libri describes a small tract printed at Lyons and dated November 12, 1608, in which mention is made of "nouvelles lunettes" made by a poor, pious and God-fearing man of "Mildebourg"; and the writer states that "even the stars which ordinarily do not appear to our view and our eyes on account of their smallness and the weakness of our vision may be seen by this instrument." From several other contemporary sources we know that knowledge of the new invention spread very rapidly, so that telescopes were not difficult to procure in the spring of 1609, both in the Netherlands and elsewhere. In December, 1608, the States General sent two telescopes made by Lipperhey to King Henry IV. of France; others were publicly offered for sale in Paris about the end of April, 1609, while the news of the invention had reached Venice in December, 1608, and a specimen of the new instrument was brought to Milan in the following May. The wonderful new toy was so very simple that it is not strange that "there was nobody who did not say he had invented it," as a contemporary writer tells us. Among these was Galileo, who in August, 1609, on the Campanile of San Marco at Venice, exhibited a telescope made with lenses purchased in that city. He claimed to have merely heard that a certain Belgian had presented to Prince Maurice of Nassau a glass by means of which distant objects were seen as clearly as if they were quite near, and that this meagre information sufficed to enable him in a single night to design a telescope. If the information received by Galileo was really as scanty as he says, it is very strange that the man who from it constructed a telescope should shortly afterwards, in his "Sidereus Nuncius," show that he hardly had grasped the most rudimentary notions as to the passage of rays of light through lenses and the formation of images. He would have done better if he had followed the explanation of the effect of convex and concave lenses given by Kepler in his book on optics, published in 1604.[1]

But even if we cannot give Galileo the credit which he demanded of having re-invented the telescope, and though, as we have seen, others before him had pointed a telescope to the stars, he deserves full credit for having at once grasped the great possibilities offered by the instrument, and for having made the first serious attempt to explore the heavens with it. He did not grind the lenses himself, but made use of such as he could purchase. Judging by the very rough sketches of the lunar surface given in his little book "Sidereus Nuncius" (published in March, 1610), his small telescopes, magnifying from three to thirty diameters, cannot have been very good; still, they were sufficient to show that the moon was a body like our earth, having mountains and plains, that the Milky Way really was composed of innumerable stars; and, above all, they enabled him to discover the four satellites of Jupiter in January, 1610. Continuing his work, he detected in the following autumn the phases of Venus and Mars, and about the same time he became greatly puzzled by the peculiar appearance of Saturn, which planet, instead of showing a round disc, seemed to be "triple." This continued to be an unsolved riddle for nearly fifty years, until Huygens, by using much improved telescopes, showed that it was caused by a detached flat ring round the planet.

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[1] See in particular Thomas Henri Martin's paper "Sur des Instruments d'Optique faussement attribués aux Anciens par quelques Savants modernes" in Boncompagni's Bulletino, iv., 1871

[1] "Opera ed. Frisch," ii., p. 56.

In the meantime, other observers lost no time in taking up the new study of the heavens. Before the end of 1608 Simon Marius, of Anspach, procured a telescope with which he found the satellites of Jupiter one day later than Galileo did. He continued for some years to follow their motions with great perseverance and skill, and produced valuable tables of them in his "Mundus Jovialis," published in 1614. Unfortunately, he roused the jealousy of Galileo, who accused him of plagiarism, an accusation which, up to a few years ago, most historians of science were inclined to consider proved, but which has now been thoroughly disproved by a detailed study of the observations of Marius by Oudemans and Bosscha. Marius was also the first to notice the phases of Mercury and the spurious discs of the fixed stars, which the imperfect telescopes of Galileo had failed to show. Even to the sun was the new instrument directed; Galileo says he saw the sun-spots in the summer of 1610, but he does not seem to have taken any interest in them at first, and did not, as usual, announce the discovery, either openly or through an anagram. Thus Johan Fabricius was the first to publish the discovery of sun-spots early in 1611, though Galileo made up for his hesitation by systematic observations, and by being the first to recognise that the spots are formations at the surface of the sun itself, and not bodies moving round the sun, as Scheiner, the third and most assiduous observer of sun-spots, for a long time maintained.

The Dutch or Galilean telescope did not for long remain the only telescope used by astronomers. Already in 1611 Kepler published his "Dioptrice," in which he clearly showed the effect of combining various lenses and the advantages of the "astronomical telescope," in which a real image of the object is formed by the object-glass at the focus of the latter, which is viewed through a magnifying convex eye-lens. A year or two later Scheiner, and following him Fontana, actually constructed and made use of telescopes of this kind, while the inconvenience of the inverted image produced by them was obviated by the introduction of an additional lens in the "terrestrial telescope" to re-invert the image formed by the object-glass. The importance of the real image, which allows a wire or a wire-cross placed at the focus to be seen through the eye-piece as sharply as, and coinciding with, the image, was recognised about 1640 by William Gascoigne, who applied a telescope to a quadrant for measuring altitudes, an application which had been suggested in 1634 by the French astrologer Morin, who, however, only possessed a Galilean telescope. Outside England Gascoigne's idea probably remained unknown, and it was not until 1667 that Auzout and Picard applied telescopes to measuring instruments, and thereby immensely increased the accuracy attainable in astronomical observations.

The importance of the invention of the telescope for the advancement of astronomy is not to be measured only by the insight it gave into the nature of the heavenly bodies, and the aid it rendered in following their movements more accurately. It also rendered an important service by making the Copernican system appear more natural and reasonable in the eyes of every unprejudiced thinker. Hitherto this system had probably to most people appeared to be nothing but a new way of "saving the phenomena" (to use an expression of the ancients), that is, a new method of calculating the motions of the planets, which anyone might use, whether he believed in the reality of the earth's motion or not. Two circumstances had contributed to give an appearance of unreality to the new system; first, the numerous epicycles which Copernicus had been compelled, like the ancients, to use in his planetary theories (because he did not know the first two of Kepler's laws, and therefore had to confine himself to combinations of circles), and secondly, the spurious preface which, without the knowledge of Copernicus, had been added to his book, in which the system was spoken of as a mere hypothesis which need not be supposed to be true. To assume the earth to be one of the planets was also a difficult thing, so long as absolutely nothing was known about the other planets. As to the moon, the ancients had supposed that it must be a body rather like the earth, and the telescope only confirmed this hypothesis. But adversaries of the Copernican system had always asked how the earth could carry the moon along with it during the annual motion round the sun, or why the moon alone should form an exception to the general rule by moving round a planet instead of round the sun? Now Galileo could point to the undeniable fact that Jupiter, during its orbital motion, carried four satellites or moons along with it. The discovery of the phases of Venus and Mercury deprived opponents of Copernicus of another favourite weapon, for they had been wont to proclaim that if Venus moved round the sun it ought to show phases like the moon. Again, the discovery of sun-spots, objects of a temporary nature, supplied a very striking proof that the Aristotelian doctrine of the immutability of all things celestial would have to be given up. While the analogy between the earth and the planets grew stronger every day, it was also of great importance that the fixed stars in the telescope appeared as mere luminous points, so that the apparent diameters of several minutes attributed to them by all previous observers were proved to have no existence. This put an end to the serious objection raised by Tycho Brahe, the greatest practical astronomer since Hipparchus, that a star having no annual parallax and yet showing a considerable apparent diameter must be incredibly large.

As it were in a twinkling of an eye, the whole aspect of the universe had been changed by the invention of the telescope. That this was felt in some way, even by determined enemies of the idea of the earth's motion, may be seen from the statement made by Clavius, the chronologist, in 1611, that astronomers would have to look out for a system which would agree with the new discoveries, as the old one would not serve them any longer. The question could no longer be, "Do you believe in the earth's motion?" it could now only be whether the arguments in favour of this motion were becoming so irresistible that the safest thing to do for its opponents would be to proclaim the doctrine to be heretical. This was accordingly done little more than seven years after the invention of the telescope. J. L. E. Dreyer.

THE YUCHI INDIANS.[1]

Anthropologists have exaggerated the evolutionary gulf between civilised and uncivilised peoples. The more we learn of the latter the narrower does the gulf appear. A remarkable case in point is that of the Yuchis of Oklahoma, recently studied by Mr. F. G. Speck.

Here we have a people engaged in agriculture and cattle-raising, like their white neighbours, wearing the same European dress, and hardly distinguishable from them except in language and colour. It is actually the fact "that many negroes and some poor whites as well are eager enough to work for the

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[1] University of Pennsylvania. Anthropological Publications of the University Museum. Vol i., No. 1, "Ethnology of the Yuchi Indians." By Frank G. Speck. (Philadelphia: University Museum, 1909.)

Indians on their plantations." Yet this people possesses a perfect set of the primitive ideas and practices illustrated in "The Golden Bough." Totemism, tabu, initiation, exogamy, reincarnation, the couvade, new fire, and the medical practice and food regulations found among the rude Australians—these and other primitive ways flourish here. They are not "survivals," but living realities, forming the warp of the social fabric.

This meeting of old and new may be partially realised by the illustration, here reproduced, of the "new fire" ceremony, which forms part of the New Year festival.

The Yuchis constitute an independent linguistic stock. A hundred years after their incorporation with the Creek Confederacy they left Georgia for the west of the Mississippi, in 1836. They now number about 500, in three "towns," and are "a remarkably strong and healthy set of people."

The clan-system is in use, based on maternal descent and totemism. The members are relatives and descendants of certain pre-existing animals, the *oiaron* of other American tribes. The Bear clan worships and protects the bear, getting bear's meat from the Deer clan, and so on. Above the clan-system is the Society or Class. The entire male population is divided into the Chief Society and the Warrior Society. Above this is the Town or Tribe.

New Fire Rite. Second Day, Annual Ceremony.

Mr. Speck's careful inquiry brings out several interesting points. Students of ballistics will be glad to know that the principle of "rifling" was used in barbarous ages. It is applied to the feathers of arrows. They are twisted so as to make the arrow revolve in its flight.

An important phase of animistic theory is connected with birth. Until the fourth day the child has not "severed all the bonds which link it with the supernatural." On that day it is fed for the first time, and receives a name. "It is then *no longer a half-spirit, but a real human being,* and belongs to earth." (My italics.)

The origin of the tribe is traced to the Sun, and at the New Year festival the town-square is represented as a rainbow. This festival is a good example of primitive ritual, comprising fasting, various tabus, scarification, the rite of the emetic, totemistic drama, inoculation against evil during the coming year, the kindling of sacred fire, and the ceremonial eating of the new corn.

Mr. Speck's interests are chiefly linguistic, but he has made a valuable contribution to general ethnology. The Pennsylvania University Museum is to be congratulated on its first anthropological publication.

MALARIA AND ITS INFLUENCE ON NATIONAL HISTORY.

WIDESPREAD disease, in the form of plagues and pestilences, has profoundly influenced the course of events, local or national, in various countries. The Biblical narrative contains instances of this, and the black death left its mark on European history; in fact, Dr. Gasquet regards the black death as the most important event of the Middle Ages, and a prime factor in the making of modern England. The presence of disease in a locality may in many ways disturb life and enterprise there. Thus the failure of the early attempts to cut the Panama Canal may in part be attributed to the terrible mortality among the labourers, principally from malignant malarial fevers, and the existence of tsetse-fly disease (which attacks horses, &c.) in wide tracts of country in Africa has rendered the problem of transport and the opening up of such districts a difficult one. Prescott, in his "History of the Conquest of Mexico," though writing without the knowledge we now possess, remarks that we find no mention in the records of any uncommon mortality among the conquerors, Cortes and his companions. Had yellow fever and malaria prevailed in the country as they have done in more recent times, in all probability the Spanish conquest of Mexico would never have been accomplished.

Similarly, the introduction of diseases into districts previously free from them may so disturb the balance that the subsequent history of such districts may be entirely altered. A modern instance of this is the introduction of malaria into Mauritius. Until fifty years ago or thereabouts this disease was unknown in these islands; it was then introduced, probably from India, and has since caused serious loss through sickness, in life and by depreciation in the value of property.

It is but a step from a consideration of specific local instances such as these to the suggestion that the introduction of diseases which have the capacity of spreading widely may modify the characteristics and subsequent history of whole nations. This theme in the case of Greece and Rome has been elaborated by Mr. W. H. S. Jones, who sees in the introduction of malaria into these empires at least one of the important factors which helped their decline and fall.

In his "Malaria and Greek History,"[1] Mr. Jones corrects and develops the theory put forward in a previous work (see NATURE, March 19, 1908, vol. lxxvii., p. 457), that man, in the struggle for existence, has to compete, among other enemies, with disease-producing parasites, that even if he is not exterminated by the disease-parasite, this may so weaken him that he falls an easy victim to his healthier neighbours.

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[1] "Malaria and Greek History." By W. H. S. Jones. To which is added "The History of Greek Therapeutics and the Malaria Theory." By E. T. Withington. Pp. x+175. (Manchester: University Press, 1909.) Price 5*s.* net.

Mr. Jones believes that malaria played a considerable part in bringing about the decline of the ancient Greeks, that this disease fell like a blight upon many fertile districts of Greece, as it almost certainly did upon Attica in the fifth century B.C.

He considers it is at least doubtful if Greece were malarious in early times. For the truth of the theory, it is not, however, necessary to prove (which is impossible) that malaria did not exist in early Greece. For, as Prof. Ronald Ross has pointed out in a recent paper,[1] even if the anopheline mosquitoes, which convey the disease, are present, provided the number of infected persons are few, the spread of infection would be slight or stationary, and the disease might fail for centuries to make headway. If, however, a number of infected immigrants make their appearance, endemic cases will increase, first slowly, then rapidly, until suddenly a widespread epidemic will occur.

In the first chapter of the book the prevalence of malaria in modern Greece and its effect on the inhabitants are discussed. In the two following chapters the evidence contained in the ancient medical and non-medical writers of the existence of malaria in ancient Greece is critically examined. The author believes that on the whole it is safe to conclude that malaria was not prevalent to any extent in early Greece; there are but two doubtful references to the disease before 500 B.C. As regards Attica, there is evidence to show that from the end of the fifth century B.C. malaria began to be prevalent. The disease is referred to in the plays of Aristophanes, and the Decelean and Peloponnesian wars gave opportunity for its spread, partly by the immigration of infected individuals, partly by the neglect of cultivation and drainage of the land, and the increase of the breeding places of the mosquitoes induced thereby.

The history of Greek medicine after 400 B.C. shows a decline in the scientific treatment of disease, and a growing popularity of the dream oracle, charms, and other superstitions, which has never been adequately explained; but it is suggested that the prevalence of malaria, which cannot be treated without quinine, might explain the growth of such superstitious practices. This theme is the subject of an interesting essay by Dr. E. T. Withington.

The condition of the Greeks before the final triumph of Rome seems to have been lamentable—they displayed want of good faith and lack of courage, they had lost ambition and cared for little but pleasure, and brutality, cruelty and vice of all kinds were rife. This period coincides, according to the evidence collected by Mr. Jones, with that during which malaria spread and became prevalent, and he believes that this decadence of the Greek character may in part at least be ascribed to the ravages of this disease. An amount of evidence is accumulated to show that in a malaria-stricken country the inhabitants lose their vigour and moral sense, and become degraded physically and mentally.

Turning now to the case of Rome, Mr. Jones, in an interesting essay,[2] from which we shall quote, similarly seeks to show that malaria exercised a powerful (though to a great extent uncertain) influence upon Roman history and Roman life.

Cicero (first century B.C.) records that on the Palatine hill there was a shrine and altar dedicated to the goddess Fever. This altar, we may remark, is also mentioned by Epictetus (Dissertations), and Pliny says that it had State recognition (both first century A.D.). Although *febris* may be used to denote any febrile condition, it usually means malaria, and the deification of fever is clear proof that it played no small part in the lives of the Romans. As in the case of Greece, the problem arises, has Italy always suffered from the plague of malaria? Many writers have pointed out that some districts (*e.g.* parts of Etruria and Latium), which are now scarcely habitable, were at one time the homes of great and prosperous peoples.

In the very early period, Rome was marshy, but the land around it well drained, cultivated, and the home of prosperous communities, and there is no reason to suppose that malaria was present. By 500 B.C. malaria was in the peninsula, Sybaris being undoubtedly infected, and by the end of the Republic, Sardinia, Sicily, Etruria, Apulia, Latium, the southern coast-line, and Rome itself were all malarious. While not to be regarded as one of the causes of the downfall of the Roman Empire, malaria, Mr. Jones considers, greatly influenced the course of events, and was a serious factor in the lives of the Romans.

Mr. Jones has developed his arguments in a decidedly convincing manner with a wealth of references to classical and modern authorities, and if he has not completely proved his case, the contents of his book and essay are very suggestive, as well as being most interesting reading.

A word in conclusion. Is it not possible that malaria has also played a part in this England of ours? There is a consensus of opinion that parts of Norfolk were once much more populated than is the case at present, as witness the numbers of large and beautiful churches that still exist. Again, within a radius of about three miles round Newchurch, in Romney Marsh, Kent, there are some ten old churches and ruins of two or three others, many more than are now required for the needs of the district, which is sparsely populated, and the same obtains more or less for the whole of the Marsh, where anopheline mosquitoes are still abundantly present, as the writer has found. Both Norfolk and Romney Marsh were formerly very malarious. Has malaria been one of the factors causing the depopulation of these localities?

R. T. Hewlett.

STATE AID FOR AGRICULTURAL EDUCATION.[1]

THE annual report on the distribution of grants for agricultural education and research in 1907–8, lately issued, is a notable volume by reason of the excellent discussion of the whole subject by Prof. Middleton, one of the secretaries of the Board. The total amount expended for education was 12,100*l.*, an increase of 550*l.* over the preceding year; the total number of students attending the various institutions was 1313, an increase of 92. The numbers are far from satisfactory in view of the fact that some 10,000 young men probably take up farming each year, whilst a certain proportion of the agricultural students do not go in for it at all, at any rate in England. Why does not the farmer take greater advantage of the opportunities for educating his sons? It is hardly a question of means, for agricultural education is very cheap and scholarships are liberally given; nor is it that the farmers do not know of the existence of the colleges. The real reason, probably, is that the farmer is not satisfied as to the value of agricultural education. Prof. Middleton has drawn up a table showing for different counties the number of men engaged in agriculture, and the percentage of the "whisky money" spent in agricultural education. It is a remarkable fact that the four counties which spend least, 10*l.* or less per 1000 male agriculturists, are purely agricultural, whilst, on the other hand, those with the smallest agricultural population expend about 150*l.* per 1000 male agriculturists. In spite of all that has been said and written on the subject, Prof. Middleton is driven to conclude that "if we except the organised work connected with the institutions, nothing approaching a system of agricultural instruction exists in England."

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[1] Report on the Prevalence of Malaria in Mauritius.

[2] "Dea Febris: a Study of Malaria in Ancient Italy." By W. H. S. Jones. Issued by the Liverpool School of Archæology. Pp. 28. (Liverpool: University Press, 1909.) Price 1*s.*

[1] Board of Agriculture and Fisheries. Annual Report on the Distribution of Grants for Agricultural Education and Research in the Year 1907–8. [Cd. 4802.] (1909.) Price 10*d.*

No one acquainted with the history of agricultural education in England will be astonished at this conclusion, or at the scepticism of the farmer. The first attempts by the old Science and Art Department to foster agricultural education brought the movement into disrepute. The village schoolmaster was encouraged to read up a small text-book, was examined on his knowledge of the text-book, and was awarded a certificate to the effect that he was competent to teach the "principles of agriculture." So long as he remained in his class-room he was secure, but directly the farmer got hold of him and began asking his advice, he was found out. Nor were later attempts more successful. Things are remembered for long in villages, and the movement has in some counties never recovered from the early errors thus committed, whilst practically everywhere these blunders have constituted a sad legacy which has only been lived down by years of hard work on the part of the institutions. These unpleasant facts are recognised, but are not allowed to paralyse further endeavours, and Prof. Middleton proceeds to sketch out a plan of agricultural education.

In the first instance, the general elementary education in country districts must be such that it arouses the intelligence of the boys and brings them to see the advantage of higher education. A beginning in this direction has already been made. Between the age of fourteen and seventeen the boy should still receive a general education either in secondary schools or at evening schools, according to his circumstances. He will not specialise in agriculture, but will develop what he has already learned, be trained to read intelligently and to observe closely. He may form collections of insects, grasses, minerals, &c., but the subject itself is of less moment than the ability of the teacher to teach it well. The teacher will presumably be allowed great elasticity in framing his time-table. From the age of seventeen to twenty special systematic instruction is to be given at an agricultural college. After he has left and started as a farmer, his education is continued at local classes by itinerant instructors, who could also deal with those who had not been to college.

In principle the scheme is excellent, but its success would depend entirely on the men whose duty it was to carry it through. The British farmer never appreciates the beauty and symmetry of a scheme, but he can appreciate a man. It was largely through ignorance on the part of the officials of this important trait in his character that the earlier efforts failed. Consequently the problem reduces itself to the provision of a sufficient number of suitable instructors. Unfortunately, Prof. Middleton does not tell us how these are to be forthcoming. He knows they do not exist at present, and he also tells us why. If a student is willing to go abroad, his prospects of earning a livelihood are satisfactory, but not if he wishes to remain in England. Thus it happens that the best men studying in our agricultural departments look forward to a career outside England, and move off to India, South Africa, Egypt, or elsewhere at an early opportunity. There is no reserve of good men. A very important reason lies in the way the colleges are managed. Prof. Middleton is probably the first official to discover that the only person on the whole college staff who receives a salary worth aiming at is the principal. No one, unless he possesses other means, can afford to remain in any other post, and when a well-trained man accepts a position on the staff, he stays only until he has picked up the technical part of his subject, and then takes other work elsewhere. Further, as it is not worth the while of a competent assistant to remain on with a view of becoming the head of the department, he accepts the first good place abroad that offers, knowing he will have to go sooner or later. The consequence is that there are not at the colleges any number of promising young men who could be put into responsible posts and trusted to carry out such a scheme as Prof. Middleton recommends.

It is not simply a case of getting a little more money to pay the staff. A farm is always a one-man business, and the farmer cannot understand anything else. The governing body of the agricultural college has the same bias; it recognises the principal, but not the members of the staff, excepting occasionally and collectively.

There are, however, signs of a change. A movement is already on foot, although little or no reference is made to it in the report before us, for affiliating the agricultural colleges to the universities. If, as we hope, the universities rise to their responsibility, they will see to it that the teaching at what is virtually their agricultural department is as good as in any other department, and they will know how to secure this end. Our hope for the future lies not so much in the action of the local committees, or even of the Government boards, helpful though these may be, as in the action of the universities themselves. As soon as they take the problem in hand matters will be righted, and the supply of young men wanted for such a scheme as Prof. Middleton's, and for the posts that are opening up in the British possessions beyond the seas, will soon be forthcoming.

LORD WALSINGHAM'S COLLECTION OF MICRO-LEPIDOPTERA.

It is not much more than two centuries ago since it was possible in England to regard a taste for collecting insects as presumptive evidence of lunacy; and a century ago Kirby and Spence thought it necessary to reply to the current objections to entomology, which represented it as a trifling pursuit, concerned chiefly with nomenclature, and leading to cruelty.

At a much later period complaint was made in some quarters that none of the trustees of the British Museum was interested in natural history; but for many years past this reproach has not existed, several of the trustees being men of high standing as naturalists, and even specialists in certain groups.

Among the foremost of these eminent specialists is Lord Walsingham, who took up the study of the smaller moths (the micro-lepidoptera) of the world about forty years ago, and devoted himself to the formation of what is now incontestably the finest and most valuable collection of these insects in the world, his lordship having supplemented the large collections made by himself in California, Oregon, South Europe, North Africa, &c., by the purchase of all the most important collections of micro-lepidoptera which came into the market, especially that of Prof. Zeller. In 1901 Lord Walsingham's collection was conveyed to the trustees of the British Museum by deed of gift, on the understanding that the collection should remain in Lord Walsingham's possession as long as he wished. Now, however, it has been arranged that the collection, consisting at present of about 260,000 specimens, and adding about 45,000 species to the small number (estimated at 4000 species) at present in the British Museum, is to be transferred to the Natural History Museum, South Kensington, early next year. The scientific value of such a collection, containing a very large number of types, can hardly be overestimated. We are glad to learn that the present inadequate staff of the museum is to be increased sufficiently to allow of special attention being given to the collection of micro-lepidoptera. Lord Walsingham has also liberally presented his special library relating to micro-lepidoptera to the museum.

The British Museum has previously benefited largely by Lord Walsingham's liberality. He has presented upwards of 15,000 specimens, including many collected during his tour in California and Oregon in 1870–1. In connection with this journey the museum published in 1879 a work on North American Tortricidæ, forming the fourth volume of the quarto series of "Illustrations of Typical Specimens of Lepidoptera Heterocera in the Collection of the British Museum." In this work, which was illustrated by seventeen coloured plates, Lord Walsingham described a large number of new species collected by himself. He also published a small volume on the "Pterophoridæ of California and Oregon," in 1880, illustrated by three coloured plates. Numerous papers containing descriptions of new genera and species of various families of micro-lepidoptera by Lord Walsingham have appeared in various periodicals, especially the Transactions of the Linnean and Zoological Societies, and of the Entomological Society of London (of which his lordship was president in 1889–90), the *Entomologist's Monthly Magazine*, &c.

Lord Walsingham has also presented an interesting collection of British macro-lepidoptera (butterflies and the larger moths), accompanied by specimens of caterpillars, mostly prepared by himself, and about fifty of the cases of British birds in their haunts which form such an attractive series in the Bird Gallery.

In conclusion, we must not omit to record that in addition to these numerous benefactions the museum is indebted to Lord Walsingham for the possession of many large and valuable collections which would not have been obtained except through his interest and assistance.

PROF. HILARY BAUERMAN.

THE world of science, and particularly the mining and metallurgical branches, have suffered a severe loss through the death of Prof. H. Bauerman on December 5 from heart failure, after an illness of nearly three months.

Born in 1833, Bauerman entered in 1851, at the age of eighteen, as the first student at "The Government School of Mines and of Science applied to the Arts" (now known as the Royal School of Mines), where he studied under Lyon Playfair, Andrew Ramsay, and Robert Hunt, and particularly under Percy, of whom he was a favourite student, and later a most intimate friend.

During so long and active a life, and starting under such excellent auspices, it is natural that a man of Bauerman's calibre should have passed through a successful and distinguished career, but only those of his more intimate friends who know the work which he actually performed in addition to the immense amount publicly known can appreciate his services to science, and particularly to its technical applications.

His uncompromising attitude on matters where he believed himself to be right, the misunderstandings caused by the slight deafness which existed during his earlier professional life and continuously increased, and the eccentricities which were part of his personality, and added to his charm, to those who knew him, prevented him from receiving such public honours as were his due. His services as one of the first rank were recognised, however, by the many societies and institutions of which he was a member of council and honorary member, and from which he received so many medals and other marks of appreciation. Among other awards, he received gold medals from the Institution of Civil Engineers, the Institution of Mining and Metallurgy, and the Iron and Steel Institute, to the latter of which he contributed a series of most important papers.

After leaving the School of Mines in 1853, he studied for three years at the Freiburg Mining Academy, and in 1855 was appointed assistant geologist to the Geological Survey of Great Britain.

His first work abroad extended from 1858 to 1863, when, as geologist to the North American Boundary Commission, he gained immense experience in accurate surveying and geological work, and laid the foundation for the careful discrimination and accuracy which characterised all his later work.

From 1864 to 1888, his professional and governmental work took him to most parts of the world except Australasia and his enthusiasm enabled him to gain a store of information on matters other than those relating to his actual work, which his prodigious memory and peculiar ability to employ his knowledge at the right moment rendered available to all who applied to him for help, or delighted those who listened to his, often apparently discursive, talk on general subjects. As a professional man and adviser on technical matters, he was pre-eminent in certain circles, but as an author and teacher he was perhaps better known. He was lecturer on metallurgy at the Firth College, Sheffield, in 1883, and succeeded Percy as professor of metallurgy at the Ordnance College, Woolwich, from 1888 to 1906, when he retired from public service, though not from active life.

It would be useless to attempt any enumeration of the public and governmental positions which he filled, but it may be mentioned that he was examiner in both mining and metallurgy for a prolonged period to the Science and Art Department, an examiner to the Civil Service Commission for Inspectors of Mines, and an outside examiner of students for the Royal School of Mines of London, and for the Camborne School of Mines. Both these positions, and many others, he occupied until his death.

His services to science and technology can only be slightly touched upon, but are, to some extent, perpetuated in his works on "Descriptive" and "Systematic Mineralogy" and the "Metallurgy of Iron," in Phillips and Bauerman's "Metallurgy," in the many valuable papers which he read before learned and especially technical societies, in the large number of notes, reviews, &c., which he contributed, often without signature, to the Press, and in the reports of juries at most of the important exhibitions.

Few of the international exhibitions have been carried through without his help, either as advisor or juryman, and he was probably the last living man who had contributed to the literature published by the juries at the close of the great 1851 exhibition. He was a member of committee and juror, commonly chairman or president, of the mining or metallurgical section, or both, at most of the British and foreign international exhibitions, and one of his latest contributions consisted in two important papers, read before the Iron and Steel Institute, on metallurgy and iron and steel at the Franco-British Exhibition, 1908.

Through the death of Prof. Bauerman one of the few members of the old school, of which his earliest teacher and greatest friend—Dr. Percy—was a type, has been lost to us; one of the most kindly and sympathetic friends to the younger members of his profession has passed away, and a most intimate companion, mentor, and friend has been lost to the writer. Only those who knew him can realise how great a loss is being experienced by his friends, and by the many councils and committees on which he served, and on which his wide experience of men and things rendered him so valuable.

Bauerman, like most great men, died in harness. Even on the day before his death he was occupied in dictating a review on a scientific work, and a few hours before he passed away peacefully in his sleep he was talking of his past labours and of the future work of the younger generation.

George T. Holloway.

THE NATURAL HISTORY MUSEUM.

The Trustees of the British Museum have sent the subjoined correspondence to the *Times*, through Dr. F. G. Kenyon, director and principal librarian of the museum.

House of Commons, December 3, 1909.

Dear Sir Archibald,—At the meeting of the standing committee of the Trustees of the British Museum held on Saturday last at South Kensington, the letters which recently appeared in the *Times* relative to the connection of the Bloomsbury and South Kensington Departments of the British Museum and the relation of their respective Directors were very fully considered. It was unanimously felt that nobody could throw a clearer light upon the matter than yourself; that nobody's voice would be so well listened to; and that nobody's opinion would carry so much weight as your own, if you could be persuaded to give the benefit of your views on the question to your co-Trustees.

I understand that you have recently had occasion to inquire into this matter; may I venture, therefore, to invite you, as one of the Trustees of the British Museum, to be kind enough to inform your co-Trustees of the opinions which you hold upon the subject-matter in question?

If I might venture to suggest, the points upon which it appears to me desirable that we should be informed are (1) whether the Board of Trustees, acting through its standing committee, is in your judgment the best authority for the government of such an institution as the Natural History Departments of the British Museum, and (2) whether, under the existing statutes and rules, the scientific management of the Natural History Museum suffers any detriment from its association with the museum at Bloomsbury.

The Trustees are anxious to be reassured that the management of the Natural History Departments of the British Museum can be usefully, adequately, and properly carried on under the present system, and feel that, as you have recently had the subject before you, and have made special inquiries into it, your judgment upon it would carry special weight.

I may say that, at the meeting of the Trustees on Saturday, November 27, I was instructed by my colleagues to deal with this matter, and I have therefore the less hesitation in approaching you directly upon it.

I beg to remain, yours faithfully,
James W. Lowther.

To Sir A. Geikie, F.R.S., Shepherd's Down,
Haslemere.

Shepherd's Down, Haslemere, December 7, 1909.

Dear Mr. Speaker,—In reply to your letter of 3rd inst. I have pleasure in stating, for the information of my co-Trustees of the British Museum, the opinion which I have been led to form on the questions you refer to me. I may say that the agitation on this subject, which has been carried on, fitfully but persistently, in the public Press for many years, supported as it has been by some well-known men of science, created in my mind the impression that there was probably some ground for the complaints that had been brought forward. But not until recently have I had occasion to make a careful investigation of the facts of the case. The result of this inquiry has been to convince me that the agitation has no substantial justification, but has arisen from misapprehension or ignorance, and that if the actual state of the matter had been realised no agitation ought ever to have been started.

The allegation so constantly made that the Director of the Natural History Museum is under much more than the merely nominal control of the Director and Principal Librarian at Bloomsbury is without any real foundation. It has probably been suggested by the fact that, as both establishments are administered by one Board of Trustees, the financial business of the whole institution is entrusted to a single accounting officer. In this obviously convenient and economical arrangement the supervision has been assigned to the Director and Principal Librarian, to whom, by Act of Parliament, every other officer of the British Museum is subordinate. But he has no power whatsoever of interference in the scientific work or management of the Natural History Museum. The duties and responsibilities of the Director of the Natural History Departments at South Kensington, as laid down in the statutes and rules, are precisely the same as those of the Director and Principal Librarian in regard to the various departments at Bloomsbury. Each of these officers is charged with the independent control of the museum and staff over which he presides. Thus the subordination of the one Director to the other is, for all practical purposes, non-existent.

I cannot conceive of a scheme which, under a board of managers, could more fully secure liberty of initiation and action in each of the two establishments. Both Directors are in immediate touch with the Board of Trustees. This board is not a bureau of secretaries and clerks in a Government department, but a body of cultivated gentlemen, full of sympathy with the objects of the great institution committed to them, anxious to promote its interests, and ready at all times to seek the best expert advice in matters which may lie beyond their personal cognisance.

It is, of course, not to be expected that any set of regulations, how carefully soever they may have been framed, will provide for every contingency that can arise from the effects of personal idiosyncrasies. In the conduct of any public institution it must be assumed that the duties assigned to the various officers of the staff will be discharged with courtesy, good feeling, and loyalty to the service. Where, unhappily, these fundamental qualities prove deficient, friction is not unlikely to arise; but any instance of it can be dealt with by the governing authority, and should not imply the necessity for a revision of the statutes, still less for a reorganisation of the institution. After a fairly wide experience, I have no hesitation in asserting that I know of no establishment, either in this or any other country, wherein more favourable conditions have been provided for harmonious and effective cooperation in scientific work than have been devised by the Board of Trustees of the British Museum for the administration of the important departments committed to their care.

I remain, yours very faithfully,
Arch. Geikie.

To the Right Honourable the Speaker of the House of Commons.

NOTES.

We announce with deep regret that Dr. Ludwig Mond, F.R.S., died on Saturday, December 11, at seventy years of age.

We regret to see the announcement that Sir Alfred Jones, K.C.M.G., who rendered valuable services to science by the share he took in the foundation and endowment of the Liverpool School of Tropical Medicine, died on December 13, at sixty-four years of age.

Mr. W. M. Tattersall has been appointed keeper of the Manchester Museum in succession to Dr. W. E. Hoyle.

We learn from the *Revue scientifique* that a monument is to be erected to the memory of Laplace at Beaumont, in Auge (Calvados), where the illustrious mathematician was born in 1746.

By the will of Mr. G. Crocker, who left an estate of 6,000,000*l.*, Columbia University will receive a fund estimated at 300,000*l.* for the investigation of cancer.

The Stockholm correspondent of the *Times* announces that the Nobel prizes for this year have been awarded as follows:—medicine, Prof. T. Kocher, Berne; chemistry, Prof. W. Ostwald, Leipzig; physics, Mr. Marconi and Prof. K. Braun, Strassburg.

The Rome correspondent of the *Times* states that the second general meeting of the International Institute of Agriculture was held there on December 12, and was fully attended by the foreign delegates, of whom more than one hundred were present.

At the annual business meeting of the Scottish Meteorological Society, held on December 8, Prof. A. Crum Brown, F.R.S., was elected president in succession to the late Sir Arthur Mitchell, K.C.B.; Sir A. Buchan-Hepburn, Bart., and Mr. J. Mackay Bernard, vice-presidents; Mr. R. T. Omond and Mr. E. M. Wedderburn, honorary secretaries; and Mr. W. B. Wilson, honorary treasurer.

The selected subject of the essay for the Weber-Parkes prize and medals, to be awarded by the Royal College of Physicians in 1912, is "The Influence of Mixed and Secondary Infections upon Pulmonary Tuberculosis in Man, and the Measures, Preventive and Curative, for dealing with Them." All essays, together with any preparations made in illustration of them, must be transmitted to the registrar of the college during the last week of May, 1912.

On November 24, exactly fifty years after the publication of the "Origin of Species," a number of biological and medical societies of the Netherlands met in one of the large halls of the Amsterdam Zoological Gardens (Natura Artis Magistra) to commemorate this event and the immense and beneficial influence which Darwinism has continued to exercise on human thought since then. Addresses were delivered by Prof. Hugo de Vries on Darwin's visit to the Galapagos Archipelago, and by Prof. A. A. W. Hubrecht on Darwin and the descent of man. The hall was crowded to overflowing, and lavishly decorated with plants, a bust of Darwin occupying the centre in front of the platform. Altogether, the commemoration was impressive and the enthusiasm spontaneous.

At the monthly meeting of the governors of the Imperial College of Science and Technology held on December 10, a letter was presented from Dr. Henry T. Bovey, F.R.S., tendering his resignation as rector. It is understood that this step has been taken owing to the condition of Dr. Bovey's health. The resignation, which came as a great surprise, was accepted with the deepest regret, and reference was made to the rector's great devotion to, and keen interest in, the important work which he had so recently undertaken, and to his unfailing courtesy and consideration in his dealings with all. Dr. Bovey was appointed rector in May of last year; and the new institution has derived a great advantage from his organising power and educational experience. The governors will shortly appoint a successor.

The *Times* of December 9 gives an account of the results of a successful expedition, under MM. Paul Pelliot and Nonette, which has just returned from Central Asia. The mission was equipped by the Comité de l'Asie française, the Ministry of Public Instruction, the Académie des Inscriptions et Belles Lettres, and a number of other societies, aided by private subscribers, the total cost being about 16,000*l.* It has accomplished topographic surveys (by Dr. Vaillant) over a distance of 3000 kilometres, on a route from Andijan, in Russian Turkestan, to Chongchu, on the Peking-Hankau line, across the Taldyk Davan range, where a height of 13,000 feet was attained. The results have been remarkable from the point of view of natural history and anthropology, but the archæological and bibliographical discoveries have surpassed all expectations. At Twen Hwang wooden statues and paintings on silk, alleged to be of date anterior to the eleventh century, were secured, also a whole library, including a Nestorian manuscript, printed records, and records stamped on wood, of the seventh century, most of them unknown in Europe and in China itself. These collections will be added to the Chinese section of the National Library.

A statement of the progress being made with the preparations for Captain Scott's Antarctic Expedition has been communicated to Reuter's Agency. Dr. Wilson, chief of the scientific staff, will also be the zoologist and artist. It is anticipated that three geologists will accompany the expedition, and that one of these will be Mr. Mackintosh Bell, director of the Geological Survey of New Zealand, who has volunteered his services. Mr. R. Simpson, of the Indian Survey Department, will be the physicist of the expedition. He is now on his way to England from Simla. A second physicist will be taken. There will be two, or possibly three, biologists. With Dr. Wilson will be associated a second medical man, who will study botany and bacteriology, giving particular attention to the investigation of blood parasites. The services of Mr. C. R. Meares, who lately completed a journey on the Chino-Tibetan border, have been secured for the expedition. He will leave England almost at once for eastern Siberia to obtain the ponies and dogs. He will collect the animals at Vladivostok, from which place they will be sent to Kobe and trans-shipped for Australia and New Zealand. Mr. Meares will join the expedition in New Zealand.

We learn from a report recently issued by the United States Department of State that during the first Pan-American Scientific Congress, held at Santiago, Chile, in January last, the following resolution on the universal time system, based on the Greenwich meridian, was submitted by Prof. David Todd, of Amherst College, U.S.A., and unanimously adopted:—Whereas (1) in the relations between the peoples of the world, diplomatic, commercial, or other, a standard of time is a common and well-recognised benefit to all; and whereas (2) the world standard of universal time, based on the division of the globe into hourly belts reckoned from a common origin, has now been in use with indisputable advantages since November 18, 1883, in certain countries; and whereas (3) practically all the European countries, Egypt, South Africa, India, Burmah, Australia, Japan, New Zealand, Canada, the United States, and other countries, have already adopted this system of universal time; and whereas (4) the necessary time-signals are now sent out daily, with all essential accuracy and without cost, throughout the American continent, by cable or wireless telegraphy: *Be it resolved,* that the first Pan-American Scientific Congress urge upon such Governments as may not already have taken this step the adoption of the universal time system referred to the meridian of Greenwich, to be effective from January 1, 1910. This comprehensive endorsement of world time by the Latin-American countries forms a fitting recognition of the twenty-fifth anniversary of the inception of a time system which has wrought all the advantages that its originator, Sir Sanford Fleming, foresaw. At the instance of Prof. Todd's representations to these Governments, both Peru and Panama had already adopted standard time officially in 1908.

THE sixty-first meeting of the American Association for the Advancement of Science is to be held in Boston, at the invitation of Harvard University and the Massachusetts Institute of Technology, from Monday, December 27, to January 1, 1910. The president of the meeting will be Dr. David Starr Jordan, of the Leland Stanford Junior University. Addresses of welcome will be delivered by Dean W. C. Sabine for Harvard University and by President R. A. Maclaurin, of the Institute of Technology. The retiring presidents of the sections, with the subjects of their addresses, so far as announced, are as follows:—mathematics and astronomy, Prof. C. J. Keyser, the thesis of modern logistic; social and economic science, Prof. W. G. Sumner; geology and geography, Mr. Willis; zoology, Prof. C. Herrick, the evolution of intelligence and its organs; physics, Prof. K. E. Guthe, some reforms needed in the teaching of physics; botany, Prof. H. M. Richards, the nature of response to chemical stimulation; chemistry, Prof. L. Kahlenberg, the past and future of the study of solutions; physiology and experimental medicine, Prof. W. H. Howell; mechanical science and engineering, Prof. G. F. Swain, the profession of engineering and its relation to the American Association for the Advancement of Science; education, Prof. Dewey, science as a method of thinking and science as information in education; anthropology and psychology, Prof. R. S. Woodworth, racial differences in mental traits. The presidents of sections for the meeting are as follows:—mathematics and astronomy, Prof. E. W. Brown, Yale University; physics, Dr. L. A. Bauer, Carnegie Institution; chemistry, Prof. W. McPherson, Ohio State University; mechanical science and engineering, Mr. J. F. Hayford, U.S. Coast and Geodetic Survey; geology and geography, Mr. R. W. Brock, Canadian Geological Survey; zoology, Prof. W. E. Ritter, University of California; botany, Prof. D. P. Penhallow, McGill University, Montreal; anthropology and psychology, Dr. W. H. Holmes, Bureau of American Ethnology; social and economic science, Mr. B. W. Holt; physiology and experimental medicine, Prof. C. S. Minot, Harvard Medical School; education, Prof. J. E. Russell, Columbia University, New York. A popular lecture will be given during the evening of December 28 by Dr. C. W. Stiles, of the Boston Public Health and Marine Hospital Service, on the hook-worm disease in the south.

WE have to acknowledge the receipt of a copy of an article on Darwin, by Prof. A. A. W. Hubrecht, published in *De Gids*, No. 12; also of one by Dr. Angel Gallardo on "Las Investigaciones Modernas sobre la Herencia en Biologia," extracted from a volume published at Cordoba to commemorate the retirement of Dr. R. Wernicke from the faculty of medicine. The latter deals largely with the main principles of the Mendelian theory.

CRUSTACEANS form the subject of two articles published in part i. (London: Williams and Norgate) of a report to the Government of Baroda on the marine zoology of Okhamandal, in Kattiawar. In the first of these Messrs. J. Hornell and T. Southwell describe a new species of pea-crab of the genus Pinnoteres infesting window-oysters (Placuna), and remarkable for the number and large size of the males, while in the second Mr. Southwell discusses the anomurous crustaceans of the same area.

THE practical improvement of ethnological collections in provincial museums forms the subject of the chief article in the November number of the *Museums Journal*, the article being an address read by Mr. F. W. Knocker at the Museums' Conference at Maidstone last summer. It is pointed out that valuable objects of this nature preserved in local museums are frequently assigned to countries wholly different from those from which they originally came, and that urgent need exists for intelligent geographical classification of such collections.

To the Transactions of the Edinburgh Field Naturalists' and Microscopical Society for 1908–9 (vol. vi., part ii.) the Rev. D. W. Wilson contributes some interesting notes on birds mentioned in early Scottish literature and documents, from which it is made evident that the crane was formerly common in Scotland, thus adding strength to the opinion of the late Mr. T. Southwell that it formerly bred in East Anglia. In another paper in the same issue Mr. J. C. Adam directs attention to the long nesting-period of the more typical members of the crow-tribe, a fact to which no allusion appears to be made in bird-books. Fourteen days for incubation and another fourteen for the nestlings to acquire their feathers is, for instance, the length of the nesting-period in the case of the thrush. In the case of the rook, on the other hand, the eggs are brooded for seventeen days, and the young require another twenty-seven or thirty days in the nest, making the whole nesting-period nearly seven weeks. The carrion-crow requires an additional week, while the raven seems to take about a week more than that species.

THE need of a regular study of the sequence of plumages in birds forms the subject of an editorial article in the December number of Witherby's *British Birds*. It is pointed out that when a bird first leaves the nest it is either naked or clothed with a down-plumage. The latter is succeeded by a juvenile plumage, acquired by a complete moult. In a few instances this juvenile dress may perhaps be indistinguishable from that of the adult, but in most cases, at any rate, it is generally possible, and often easy, to differentiate between the two. In some instances, when the dress of the adults of the two sexes is different, the juvenile plumage approximates more or less closely to that of the female, but more commonly it is markedly different from that of both adults. It may be spotted or streaked, it may show light borders to the feathers, it may be duller than that of the adult, or may be altogether distinct. It is proposed to institute a careful study of these early plumages of British species, and then of their successive summer and winter liveries season by season.

IN a report on the progress of game-protection in the United States during 1908, published in the Year-book of the Department of Agriculture, Mr. T. S. Palmer states that the year 1908 was not marked by any event of special importance, but a number of factors, at least in certain localities, affected the condition of game and the success of the hunting season. On the whole, the game wintered well, and conditions in the spring were better than normal. During the summer a prolonged drought, accompanied by forest-fires, occurred in several of the northern States, and threatened serious injury to deer and grouse, but the loss proved less than predicted. In the Carolinas and Georgia floods in August and September caused great destruction of deer and wild turkeys. The difficulty of obtaining game-birds for stocking coverts increased interest in the grey partridge of Europe, and resulted in the importation of a much larger number of these birds than in any previous year. The rapidly increasing popularity of the automobile and the motor-boat in the pursuit of game is apparently affecting the abundance of certain species in some localities, and indicates the necessity for better regulation of such methods of hunting.

In a recent number of the Proceedings of the Zoological Society of London (October) Dr. F. Wood-Jones gives an abstract of his remarks on the new theory he has formulated on the origin of coral reefs and atolls. According to his view, the presence or absence of sedimentation determines, in the first place, whether the reef corals are not, or are, able to form a reef on a submerged bank. The tendency of reefs, once started, to become "basin-shaped" is due to the sediment that falls and settles on the side of the reef that is protected by the growing corals from the washing action of the sea currents. When the reef reaches the tide limit the waves hammer fragment against fragment and form a quantity of coral débris, which becomes cemented into a solid breccia to form the basis of the coral island. A small coral island once formed in this manner provides an impediment to the current, and the burden of sediment the current carries is deposited in stream lines from its extremities. "In this way the form of the island tends to becomes a crescent." The theory is ingenious and full of interest, but until the full paper, which we may hope will be adequately illustrated, is before us, it is difficult to believe that it will entirely supplant the older theories of "subsidence" or of "solution." Neither the simple and beautiful theory of Darwin nor the more complicated but still fascinating theory of Sir John Murray have received universal support; it is hardly possible that Dr. Wood-Jones's theory of sedimentation will prove to be capable of solving all the difficulties.

The first appendix to the *Kew Bulletin*, 1910, has been issued. It contains, as usual, the list of seeds of hardy herbaceous plants and of trees and shrubs which have ripened at Kew during the year and are available for exchange with botanic gardens and regular correspondents.

A paper of much interest contributed by Dr. Th. Weevers to *Recueil des Travaux botaniques Neerlandais* (vol. vi.) discusses the physiological significance of some glucosides. The author previously studied the glucoside, salicin, present in twigs of *Salix purpurea* as a reserve product, and observed that when the shoots start growing it gives place to a body saligenin, and apparently this in turn to catechol. He now reports the discovery of the enzyme, salicase, which decomposes salicin. Further, he identifies two oxidation ferments, which act upon saligenin and catechol respectively. These and other results lead to the following argument. During the summer salicin is formed in the leaves by day, but is decomposed by night, and the glucose is transported to the cortex; each day the catechol combines with more glucose to form salicin. In the autumn the process ceases, because the cortex contains as much salicin as the leaves. These conclusions agree with the hypothesis that benzene derivatives combine with carbohydrates to form substances which diffuse with difficulty, and that serve to keep the sugar stored in the tissues.

An essential feature of the scientific investigations undertaken at the Rothamsted Experimental Station is the practical bearing of the problems involved; this is evident in the papers originally published in the *Journal of Agricultural Science* (October), now issued in pamphlet form from the Cambridge University Press. A communication by Drs. E. J. Russell and H. B. Hutchinson deals with the effects produced by partial sterilisation of soils. When a soil is heated to 95° C. or treated with volatile antiseptics, *e.g.* carbon bisulphide, it becomes more productive for a while. The authors find that there is an increase in the production of ammonia, which is due to a rapid increase of bacteria. Reasons are given for believing that the chief factor is the destruction by sterilisation of large competing organisms of the nature of protozoa. If this be so, it is possible that some method may be devised for suppressing these undesirable soil organisms, and the authors state that this practical question is receiving attention. Drs. H. B. Hutchinson and N. H. J. Miller have attacked the problem of nitrogen assimilation by plants to test the evidence in favour of direct absorption of ammonium salts. Experiments were conducted with wheat and peas grown in water and sand cultures under the conditions necessary for excluding nitrifying organisms. The results show that these plants can take up their nitrogen entirely in the form of ammonium sulphate, although wheat thrives better when supplied with a nitrate. It is mentioned that other investigators have found a partiality for ammonium salts in the early stages of a plant's existence, while nitrates have been necessary or more fruitful in later stages.

Solid carbon dioxide is now being used for refrigeration in the treatment of certain affections of the skin. The substance is obtained in the form of a snow by allowing the gas to escape from a cylinder in which it is compressed. This snow is placed within a tube of metal or vulcanite, and packed by using a solid rod which fits into the tube as a rammer. In this way round or square rods of solid carbon dioxide can be obtained. A rod may be held in the hand with a turn or two of lint intervening, and the free end may be pared to any shape by means of a knife, as it is quite firm. On applying the end of a rod of this kind to the skin with pressure, the frozen surface immediately becomes white and hard. The process of thawing occupies about the same time as the application. Reaction sets in at once, the treated area becoming perceptibly swollen in two or three minutes. A wheal forms within half an hour, and often a blister is produced within an hour, though with short applications this does not occur. An application of thirty seconds or more is followed by scarring. The application is practically painless. The method is chiefly of use in the treatment of capillary nævi of less than 1 inch diameter. The average duration of the application is about forty seconds. "Port-wine mark" is dealt with in this way. Some moles are amenable to this treatment, and it answers well for warts. In the case of warts a longer application is necessary, say one to one and a half minutes, pressure being continued until a narrow zone of healthy tissue is frozen around the base of the wart. Keratoses (horny growths of the skin) are among the diseases amenable to this method of treatment. It is too early to say what will eventually be the scope and limits of the therapeutic utility of this agent, but the method is of interest as an instance of another application of physics to medicine.

It is well known that in animals such as the vertebrates, which have a closed vascular system, the nutrient function of the blood is exercised upon the tissues through the intermediation of lymph, that is, the fluid part of the blood which leaks through the thin walls of the blood-capillaries. The problem of lymph formation is fraught with interest, and has exercised the attention of many physiologists. The word leakage just employed, however, implies that the main factor in its formation is the mechanical one of filtration, but this is by no means the truth, or at any rate the whole truth. Osmosis is another physical process concerned, and the labours of physical chemists in elucidating the laws of osmosis have been important from the physiological point of view; but, in addition to physical forces, the physiological or "vital" properties of the living capillary wall have to be taken into account, and the secretory nature of lymph formation was ably insisted upon by the late Prof. Heidenhain. A somewhat similar set of factors has to be reckoned with in the question of urine formation in the kidneys, and different physiologists hold diverse views concerning the relative importance of the physical and physiological factors concerned. Those interested in the latest development of such discussions, mainly in relation to the formation of lymph, will find them ably discussed in a little pamphlet written by Prof. Asher, of Berne, who has devoted much of his research work in this direction. It is entitled "Der physiologische Stoffaustausch zwischen Blut und Geweben," and though published separately it forms part of a larger work which is being written by collaboration under the editorship of Profs. Gaupp and Nagel, called "Sammlung anatomischer und physiologischer Vorträge und Aufsätze" (Jena: G. Fischer).

MISS E. B. VAN DEMAN contributes to the Proceedings of the Carnegie Institution of Washington an elaborate monograph on the Atrium Vestæ at Rome. This building was first discovered in 1883 at the foot of the Palatine Hill in the Forum, and the excavations have been since carried on at intervals. The investigation of the site is particularly difficult, because, owing to successive outbreaks of fire, the building was reconstructed or restored no less than five times from the Republican period down to that of the later Empire. The most interesting point disclosed by the excavations is that the dwelling of the Vestal Virgins, who guarded the sacred fire, was an adjunct to that of the early king and queen. The queen, as materfamilias of the State, supervised the duties of the Vestals. This fact furnishes strong evidence in support of the theory enunciated by Prof. J. G. Frazer, some five-and-twenty years ago, that the Vestals were originally the daughters of the king, and as such were naturally placed in charge of the sacred fire which was kept alight in the house of the king, and on its maintenance the safety of the State was supposed to depend.

THE December number of the *Geographical Journal* contains a second interim report of the committee of the society on progress in the investigation of rivers, by Dr. Aubrey Strahan. The chief work of the year includes observations of flow, temperature and composition of water, and estimations of dissolved and suspended matter, in the rivers Exe and tributaries, the Medway, and the Severn. A number of notes on special points is appended to the report, and Dr. Mill contributes an extremely valuable paper on the rainfall of the Exe Valley.

MR. V. STEFÁNSSON contributes a short paper on northern Alaska in winter to the Bulletin of the American Geographical Society. The author points out that whereas driftwood was formerly abundant along the entire north coast of Alaska, very little now comes ashore anywhere west or south from Point Barrow, showing that this section of the coast depends for its driftwood on the Yukon River, the banks of which have recently been deprived of much of their tree-growth. A few years ago the Eskimos of northern Alaska might have been broadly classified as inlanders and coast people, but now most of the inlanders have moved to the coast, starved out by the disappearance of the caribou, which has been slaughtered indiscriminately for about twenty years.

IN the Journal of the Scottish Meteorological Society for the year 1908 (vol. xv., third series) Mr. A. Watt, secretary to the society, gives a very interesting summary of the development of the exploration of the upper air by means chiefly of kites and unmanned balloons, from the early experiments of Wilson, Archibald, and others in Great Britain, and Espy, Rotch, and others in the United States, until the present time, together with a brief description of the results relating (1) to the general circulation of the atmosphere, and (2) to the temperature conditions at great heights. It is not claimed that anything new is contained in the paper, but it gives historical notes, and references to original discussions that have appeared in our own columns and other journals of a scientific character, which will be very useful to anyone interested in this important subject. The author thinks that these researches are "perhaps the most brilliant chapter in the history of meteorology."

IN the *Physikalische Zeitschrift* for November 22 Dr. T. Wulf directs attention to the advantages of using calcium carbide as a drying material in electrostatic instruments the insulation of which is to be maintained. He has found that a small piece of the substance will keep the interior of an electroscope he uses for measuring the γ rays from radio-active materials quite dry for several weeks, although the instrument stands in the open exposed to rain. The active surface of the material is kept free owing to the dry powder due to its action falling from the surface as it is formed. The efficiency of the carbide seems to be rather better than that of sodium.

MISS LAURA L. BRANT, of the Brown University, Providence, gives in the November number of the *Physical Review* the results of her re-measurement of the magnetic and electrical properties of a score of steel rods which were made glass-hard and then tested by Prof. Barus in 1885. They were again tested by him in 1888 and in 1897, so that we now have a record of the change of the properties of this steel when kept at ordinary temperatures for twenty-four years. In all cases there has been a diminution of the electrical resistivity of the steel of about 20 per cent. in the twenty-four years, the change having taken place along an exponential curve. The same result would have been reached in three hours if the rods had been heated to 100° C. Miss Brant concludes that glass-hard steel will, if kept at ordinary temperatures, be completely softened in 250 years.

MR. E. MERCK, 16 Jewry Street, E.C., has issued his annual report of recent advances in pharmaceutical chemistry and therapeutics for 1908, vol. xxii., dated from Darmstadt, August, 1909. The present volume has grown to nearly 400 pages, the index of authors alone covering thirty columns, and including more than 1000 names. A hundred pages are devoted to a monograph on organotherapy and organotherapeutic preparations, the remainder of the report being occupied with detailed notes on preparations and drugs, these being arranged in alphabetical order for convenience of reference.

MR. L. OERTLING has sent us a copy of his new illustrated catalogue of assay, chemical, and bullion balances. More than fifty balances are illustrated, ranging from a bullion balance constructed to carry 10,000 oz. and turn with 10 grains, to an assay balance carrying 1 gram and weighing to 0·005 milligram. Among the new balances not previously shown is the ampere balance made for the National Physical Laboratory, weighing to a milligram when loaded with 5 kilograms in each pan. In the case of the weights, it would be desirable to indicate the accuracy of adjustment, if only as explaining the apparent anomaly, a set of weights ranging from 50 grams to 1 milligram being quoted at 2*l.* 5*s.* on p. 59 and at 15*s.* on p. 61.

Messrs. Gallenkamp and Co., Ltd., have favoured us with a copy of their catalogue of spectroscopes, spectrometers, vacuum tubes, induction coils, and other accessories essential to modern spectroscopical research. After examining the publication carefully we recommend all who are engaged or interested in such work to acquire a copy, for it is plentifully illustrated, the instruments are described in detail, and instructions are given as to how they should be set up for the best use in various researches. The accessories for the production of spectra, such as tubes, burners, coils, and cells, are very numerous, and the firm makes a speciality of vacuum tubes to which we have previously directed attention (vol. lxxi., p. 448). The "C" type of tube, in which the illuminated gas is viewed end on in a capillary tube, without the interference of the electrodes, is now made in Uviol glass and with ground-in quartz windows, so that investigations of the ultra-violet part of the spectrum may be carried out with the various ultra-violet spectrographs figured and described in the catalogue.

Some results of trials of the new transmission gear for marine turbines constructed for Mr. George Westinghouse to the designs of Rear-Admiral George W. Melville and Mr. John H. Macalpine appear in *Engineering* for December 3. In this gear the reduction of speed from 5 to 1 is attained by the use of double helical spur wheels and pinions mounted in such a manner as to secure an even distribution of the bearing pressure between the teeth. The full load to be transmitted is 6000 horse-power at 1500 revolutions of the pinion shaft, and a special hydraulic brake was employed in the tests to take up the load. A few of the results are given in the following table:—

B.H.P. delivered by gear	3712	4156	4576	5036	5486	5927
B.H.P. of turbine	3771	4197	4623	51 8	5567	6057
Efficiency, per cent.	98·7	99	98·9	98·7	98·5	98·7

This efficiency is very remarkable, being as good as has been recorded with the best cut gears of ordinary dimensions. An endurance test of the gear at full load has also been carried out, extending from 3.15 on Saturday afternoon until 7.15 the next Monday morning. During the last thirty-four hours of the run the temperature of the gear remained constant, and there was every indication that the trial could have been extended indefinitely. The performances of this gear on board ship will be looked for with interest, both as regards the working of the gear and the anticipated economy which will result by running both turbine and propeller at their best speeds.

The conditions of award of the prize of 1000*l.* offered by Mr. Alexander for a British-built aëronautical engine have now been issued. We extract the essential conditions from *Engineering*, as follows. The engine must develop not less than 35 brake-horse-power, and not exceed 245 lb. weight; that is, 7 lb. per horse-power, including all parts necessary for running, cooling apparatus, and accessories. Arms suitable for bolting down to a testing bed are included in the weight, and such arms must be arranged so that the motor-shaft is not less than 16·13 inches above the test-bed. The points on which the award will be given are:—(*a*) weight and petrol consumption; (*b*) trustworthiness and steadiness of running; (*c*) wear of working parts; (*d*) security against fire; (*e*) air-resistance offered by motor. Each motor will be tested on a 24-hours' run, and if the stoppages during this time exceed three, or if the total time of stoppage exceeds thirty minutes, the motor will be disqualified. The balancing will be taken into consideration, and the engine will also be tested at an inclination of 15 degrees, first one way and then the other, an hour's run each way being given. A thrust of 175 lb. will be applied during the tests to represent the thrust of the propeller. The tests will be made in an air current of thirty miles per hour. The regulations comprise subsidiary details, but the above are the essentials. The tests will be carried out at the National Physical Laboratory under the sole control of the advisory committee, and entries may be made not earlier than February 1 and not later than April 30 on entry forms which may be obtained from the secretary, advisory committee for aëronautics, Bushy House, Teddington.

Messrs. Longmans, Green and Co. have published a seventh edition of Prof. W. D. Halliburton's "Essentials of Chemical Physiology for the Use of Students." Scarcely a page of the book has escaped revision, and a new lesson on some typical organic compounds has been included in the book.

A third edition of the "Elementary Treatise on Electricity and Magnetism," by Prof. G. Carey Foster, F.R.S., and Prof. A. W. Porter, has been published by Messrs. Longmans, Green and Co. The whole book has been revised, and many additions have been made. The final chapter has been re-written, and provides a good summary of recent progress in electrical science.

Mr. M. Kanade, Baroda, India, has sent us a copy of a list of books he has compiled and classified according to the system, known as the decimal classification and relative index, devised by Mr. M. Dewey, director of the New York State Library. The catalogue does not make it quite clear how the books chosen for classification have been selected, but the scheme provided for the classification of the works in any library should prove useful.

OUR ASTRONOMICAL COLUMN.

Daniel's Comet, 1909*e*.—A second observation by Prof. Daniel of the comet discovered by him on December 6 is reported by a telegram from the Kiel Centralstelle, and the following elements and ephemeris, computed by Dr. Ebell from observations made at Princeton (December 7), Northampton (December 8), and Nice (December 9), are published in Circular No. 116 from the Kiel Centralstelle:—

Elements.

T = 1909, December 5·6011 (Berlin).

$$\left.\begin{array}{l}\omega = 8^\circ\ 16{\cdot}42' \\ \Omega = 73^\circ\ 33{\cdot}08' \\ i = 26\ \ 56{\cdot}90'\end{array}\right\}1909{\cdot}0$$

$\log q = 0{\cdot}19674$

Ephemeris 12h. (M.T. Berlin).

1909	α h. m.	δ ° ′	log Δ	Brightness
Dec. 13	6 18·1	+39 31·0	9·789	0·99
15	6 18·4	+41 6·2		
17	6 18·7	+42 38·8	9·794	0·96
19	6 18·9	+44 8·4		
21	6 19·0	+45 34·7	9·802	0·92

As the comet is travelling northwards through Auriga, nearly parallel to the line joining θ and β Aurigæ, it will probably remain observable in the northern hemisphere for some time.

The above elements show a likeness to those of comet 1867 I., but are, as yet, too uncertain to permit of any definite conclusions.

It will be seen from the ephemeris that the comet is now receding from the sun, and is becoming fainter; the unit brightness, at time of discovery, was given as 11·0.

Halley's Comet, 1909*c*.—A further ephemeris for Halley's comet, based on the assumption that perihelion passage will take place at 1910 April 19·67, is published in No. 416 of the *Observatory* (December, p. 476), and extends to April 5·1 (Berlin Time). In the interval the comet will pass from Taurus, through Aries, graze the northern limit of Cetus, and traverse Pisces. The short time that the orbit plane of the comet lies above the plane of the ecliptic is shown by the fact that the ascending and descending nodes are passed on January 17·9 and May 18·6, 1910, respectively; on the latter date the comet transits the sun. For seventy-eight days it remains inside the earth's orbit, being at unit distance from the sun on March 11·6 and May 28·7 respectively. At the beginning of March the comet will set about three hours after the sun, and will probably be unobservable from the end of the first week until nearly the end of April; then it will become observable before sunrise.

Numerous visual observations are now being recorded. Among others, Prof. Schorr reports that Dr. Graff saw the comet, with the $9\frac{1}{2}$-inch equatorial of the Hamburg Observatory, on November 18, as an elongated nebulous mass, whilst Herr H. Thiele saw it with a $4\frac{1}{2}$-inch comet-seeker. A number of observations are also reported in No. 4373 of the *Astronomische Nachrichten*. According to a *Daily Mail* correspondent, the Greenwich photographs show curious fluctuations of brightness. On November 22 the comet was of the tenth magnitude, whilst on November 30 it was of the twelfth, although on December 1 it was again brighter.

Mars.—In the December number of the *Observatory* the Rev. T. E. R. Phillips briefly reviews the various observations which have been made of the Martian features during the present opposition. His own observations indicate that the polar cap was not symmetrical about the pole of rotation, but was further from the south limb when the central meridian lay between longitudes 300° and 50° than when the other side was presented. The canals, generally, have not been well seen by Mr. Phillips, and only the Euphrates has been seen duplicated. He also refers to the lack of brightness in the white regions so well seen in 1903. Six drawings of the planet, by Mr. Phillips, accompany the note, and illustrate the various points to which the author refers.

Observations of Jupiter.—In No. 4372 of the *Astronomische Nachrichten* Herren H. E. Lau and C. Luplau-Jannsen describe their observations of Jupiter made during the period January–May of this year. Numerous spots were seen in the different bands, the activity of the southern hemisphere in this respect during the recent oppositions apparently exceeding that of the northern. Band iv. appeared redder than hitherto, and the bright central line more irregular. In April a remarkable projection was seen on the southern edge of band v., darker than the band itself, but apparently partaking of the general motion of that region. Important changes took place in the visibility and form of the Great Red Spot between the end of January and the end of March, and on March 28 the spot itself could not be seen, although its place was partially occupied by a bright egg-shaped mass. A discussion of these changes and a number of measures of the various features also form part of the paper.

In No. 4373 of the same journal Dr. H. H. Kritzinger asks that all those observers who have unpublished measures of the position of the Red Spot will kindly communicate the same to him at 7, Hindersinstrasse, Berlin N.W.

A Solar Physics Observatory for Australia.—The importance to solar physics of the installation of a properly equipped observatory in Australia can scarcely be overestimated, and it is therefore with great pleasure that we learn, from the *Observatory*, that the labours of Dr. Duffield and others in this direction are likely ultimately to become fruitful.

At a meeting held on October 26 a number of prominent Australian officials discussed the matter, and His Excellency the Governor-General, Lord Dudley, in a carefully reasoned speech, pointed out the urgent necessity for the establishment of such an institution. He pointed out that a capital expenditure of at least 10,000*l.*, and an annual expenditure of about 1500*l.*, would be necessary, but if Australia is to use the exceptional advantages of position and climate which it possesses, and to take her place among the other nations in the progress of science, this opportunity should not be neglected. After discussing the matter at length, the meeting agreed to the following motion:—"That the establishment of a solar observatory is desirable, and that the Federal Government be strongly urged to assume the responsibility of carrying it into effect." Already some 1000*l.* has been raised among private donors, and it has been officially suggested that the Commonwealth Government will materially help the fund, and, in the event of the effort being successful, provide for the maintenance of the observatory. From the opinions expressed by several influential Australian papers it appears very probable that this much needed institution will ere long become established.

The Hamburg Observatory.—We have received from the director, Prof. Schorr, the reports of the Hamburg Observatory for the years 1907 and 1908. In the latter is an account of the removal of the observatory to Bergesdorf and of the new instruments installed therein.

Ephemerides for Perrine's and Winnecke's Comets, 1909*b* and 1909*d*.—Ephemerides for comets 1909*b* and 1909*d* are published in No. 4374 of the *Astronomische Nachrichten* by Dr. Ebell and Prof. Hillebrand respectively. As both these objects are faint, and south of the equator, it is not worth while reproducing the ephemerides here.

A CONTRIBUTION TO APPLIED BOTANY.[1]

OWING, it seems, to the dilatoriness of some of the contributors, the annual report of the German Society of Applied Botany for 1908 has only lately appeared. The society, now numbering 260 members, held its sixth meeting at Strassburg early in August, and ought not to require twelve months for the publication of its report. A curious feature in it is the separation of the account of the discussion of the contents of a paper from the report of the paper itself. It would be more convenient if the two were combined, and the paper followed by the speakers' observations in each case. Thus "Diskussion zur Appel," early in the volume, refers to a paper by Appel at the end.

Wittmack directs attention to the confusion caused by the want of uniformity in the views expressed by experts on botanical matters, affecting especially the German Customs' Department. He recommended the appointment of a technical committee and the publication of its decisions in a special bulletin. This was subsequently found impracticable, and the society decided to utilise its annual report for such purposes as far as possible. As Wittmack's article itself indicates, the expert forces of Germany are so systematised in the various industries that there is little need for a new organisation.

In this report the amusing case of the "everlasting plant," *Selaginella lepidophylla*, is described in detail. Wittmack reported that the plant, as imported for sale as a curio, is dead. Brick, of the Hamburg Plant-protection Station, however, reported that the imported plants are often, as several botanists have shown, living. Any such living plant imported into Germany must pay a tax and be examined for freedom from vine-louse and the St. José scale-insect. Fortunately, common sense prevailed, and the plants are now allowed into Germany as curios.

Mez compares *Merulius lacrymans* with other forms of dry-rot, and shows that it, unlike, *e.g.*, *Polyporus vaporarius*, prepares its way by moistening the timber with the "tears" it produces by its respiration, from the carbohydrates derived from the timber destroyed by it. The practical importance of this is great.

Klebahn describes experiments on the solvent action of root-secretions on "agriculture" and other phosphates. Wittmack defines the term "bulbs" as used horticulturally.

Voigt shows how seriously the contract cereal trade through Hamburg is affected by a correct application of the term "wild oats" in grain analysis, Hamburg and Berlin differing in their interpretation of it.

Muth contributes a comprehensive account of the varied part botany should play in the experimental work of agricultural stations, and shows that neither botany nor botanists occupy their rightful position at present in

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[1] Jahresbericht der Vereinigung für angewandte Botanik. Sechster Jahrgang, 1908. Pp. xlii+294. (Berlin: Gebrüder Borntraeger, 1909.)

Germany, especially in comparison with applied chemistry and its followers.

H. Fischer, the discoverer of the symbiosis of N-bacteria with microscopic soil algæ, in a valuable article on soil bacteriology, summarising and discussing the results already obtained, urges the necessity of treating the subject as a botanical one and of encouraging botanists to devote themselves to it if advances commensurate with its practical importance are to be made. Thus at present there is, he states, no known method of bacteriological soil investigation which satisfies the requirements of science and practice. Exclusive of the discovery of the N-fixing power of the bacteria of leguminose roots, little of practical value has so far been ascertained. *Azotobacter chroococcum* is, in passing, quoted as a calcicole plant, thus serving, like some flowering plants, as a soil indicator.

Wieler writes on the smoke nuisance as it affects plant life. He shows how little the subject is understood, urges the creation of a smoke institute for the investigation of smoke problems, and the employment in legal cases of smoke experts as judicial arbitrators. Wieler reviews critically the publications of recent years on smoke, and deals especially with the sulphur compounds on which he has himself worked. The prevention of damage to plant life by smoke is a botanical subject.

P. Sonntag describes the results of his examinations of the ductility and breaking point of the bast fibres of some half-dozen different palms, corrects earlier observations on the subject, and shows the practical bearing of the question, *e.g.*, on the selection of fibres for street sweepers.

Count Arnim, well known for his devotion to the production of new varieties of cereals, contributes a stimulating article on the production of new varieties of potatoes. He contends that hitherto the method pursued has been empirical, the object having been to meet the speculative trade demand for new varieties each year. Scientific men are invited to answer certain questions pressing for solution, and to aid the conscientious practical man in the search for trustworthy starch-producing disease-resisting varieties. Results hitherto obtained in potato-culture experiments are of necessity contradictory, not being based on scientific principles.

L. Bernegau deals with the utilisation of dried potato tubers and of the sweet-potato (batatas) in the German colonies of West Africa. The article is of value to all interested in the industrial application of colonial economic products. Other articles by Bernegau deal with the Togo lemon (*Citrus medica*) and with *Cola acuminata* and *C. vera* seeds.

One of the most important papers in the volume is that by F. Muth on the influence of the nature of the seed-bed on the germination of seeds. Contrary to the opinion prevailing in Germany that, though the nature of the seed-bed is of minor importance, strong filter or blotting paper is the best medium, Muth finds, as a result of many trials of every kind of seed, that blotting paper for most seeds does not provide the best seed-bed. He recommends unglazed white or yellow porcelain dishes. The results of the seed-testing in the Government station in Ireland, of which I have charge (more than 2000 tests being made annually), fully support Muth. Further, we find that for cereals a soil-test, apparently not tried by Muth, gives better results than the porcelain dishes. Brick supplies an illustrated account of the diseases of cocoa, rubber, and other tropical plants of cultivation, and Appel a, now somewhat belated, paper on potato leaf-roll.

The report is one which no one concerned with economic botany should overlook, and reveals the many-sided practical bearings of botany. T. J.

A NEW METHOD IN ANIMAL PSYCHOLOGY.

THOSE who remember the Huxley lecture delivered in 1906 by Prof. Pawlow, in which he complained that the physiology of the sense organs had hitherto suffered from the evil influences of psychology, will turn with interest to a paper entitled "The Method of Pawlow in Animal Psychology," which is contributed to the August number of the *Psychological Bulletin* by Messrs. R. M. Yerkes and S. Morgulis. The method which Prof. Pawlow introduced consists in studying the modifications of the salivary reflex under various mental conditions. By a simple operation a salivary fistula is formed on the outer surface of the cheek of a healthy dog; the wound quickly heals, and the animal suffers no further inconvenience. The flow of saliva under different conditions is studied by collecting it from the fistula and observing its volume and viscidity in given intervals of time. Pawlow calls the salivary reflex "unconditioned" when (as, for instance, on the introduction of food into the mouth) the stimulus naturally and directly calls forth the reflex. On the other hand, a "conditioned" reflex occurs through artificial and indirect causes. Thus, if a sound of constant pitch is produced near the dog on every occasion when food is given, this particular sound (after adequate practice) is sufficient to cause a secretion of saliva in the absence of food. According to Nicolai, the "reflex" thus obtained is a complicated process, the secretion being connected only indirectly with the sound-stimulus by the mediation of the "idea of eating." When once such a conditioned "reflex" has been established, the interest of the experiment consists in seeing to what extent, if at all, the "reflex" is evoked by modifying the stimulus, *e.g.* by varying its pitch, timbre, or loudness, or by including the tone in a chord.

The paper gives a lengthy *résumé* of the study of auditory reactions made in this way by Selionyi, one of Pawlow's pupils. A paper by Orbeli, another of his pupils, also written in Russian, is likewise abstracted in considerable detail. This deals with the visual reactions of the dog. The writer concludes that the "study of conditioned salivary reflexes furnishes no indication that rays of light of different wave-length are received as distinct stimuli by the eye of the dog," although such reflexes "are essentially dependent upon the intensity of the light-stimulus." Nicolai likewise fails to find evidence of colour-vision in the dog. It would, however, be rash to conclude from these experiments that dogs are colour-blind. The dogs mostly used in Pawlow's laboratory were a mixed breed of hunting dogs, and it may well be that in this particular breed colour-differences are very ill attended to. Moreover, it is quite conceivable that when an animal has been trained to salivate, say, to a blue stimulus, a yellow stimulus may also cause salivation, and yet may be clearly distinguished in the dog's consciousness from the blue. This shows the weakness of Pawlow's method and the cautions which are necessary in deducing the mental states of an animal from the study of its salivary secretion. To judge from the list of forty-two papers published (mostly in Russian) by Pawlow and his pupils since 1904, the St. Petersburg school of physiologists has unbounded faith in the possibilities of the method.

THE MESSINA EARTHQUAKE.

THE Messina earthquake of December, 1908, will probably occupy the attention of Italian seismologists for some time to come. In the meantime, Dr. Mario Baratta has published a summary of the results at which he has arrived during an investigation made under the auspices of the Italian Geographical Society. The great shock, he remarks, was not announced by any slight movements in the district chiefly affected. The greater part of this district lies in the Calabrian peninsula, bounded by a line which just includes Palmi, San Procopio, San Stefano, and Pellaro. In Sicily the bounding line includes Faro Superiore, close to the north-eastern corner, and passes a short distance to the west and south of Messina; but, even in this region of maximum devastation, there are small areas within which the buildings appear to have been miraculously preserved.

Excluding Reggio and Messina, where the number of victims is still unknown, the mortality reached a maximum at Cannitello, with a percentage of 42·7; in a few places it ranges from 20 per cent. to 30 per cent., more frequently it lies between 10 per cent. and 20 per cent., while in most places it was less than 10 per cent. Besides the principal meizoseismal area, there are other regions marked by an increase of intensity, such as the well-known zones of Monteleone, La Piana, Ferruzzano, &c., so strongly disturbed in 1905, 1783, and 1907 respectively.

In the chief meizoseismal zone the shock was preceded by a very loud rumbling like the firing of a gun, and the perceptible movement, which occurred in three separate phases, was estimated to last about thirty seconds. The time of the shock within this area is known with considerable accuracy, the clock at the geodynamic observatory of Messina having stopped at 5h. 21m. 30s., or 4h. 21m. 30s. Greenwich mean time. On the Calabrian shores, the sea-waves were greatest at Pellaro, Lazzaro, and Gallico; in Sicily, near Briga, Riposto and Paradiso; they were distinctly perceptible at Malta, and were registered by the tide-gauges at Porto d'Ischia, Naples, Civitavecchia, Porto Corsini, and even in the neighbourhood of Venice.

Dr. Baratta attributes the disastrous results of the recent earthquake chiefly to three causes—the damage resulting from preceding earthquakes, and especially those of 1894, 1905, and 1907; the nature of the rocks on which the houses were built; and the wretched materials used and a system of construction in complete contradiction to the elementary rules that should govern all building in seismic countries. He gives the following scale of foundations, beginning with the worst:—yellow sands, sands and conglomerates in irregular beds, recent alluvia, Miocene sands and conglomerates, limestones and crystalline rocks. The recent earthquake he regards as far inferior in intensity to the first great shock of 1783, which produced permanent changes in the ground and attained a maximum mortality, though occurring in the daytime, of 77 per cent. at Terranova.

PHTHISIS AND INSANITY IN RELATION TO INHERITANCE.

A MEMOIR "On the Inheritance of the Diathesis of Phthisis and Insanity," by Dr. Charles Goring, has been issued by Messrs. Dulau and Co. in the series of Drapers' Company Research Memoirs, emanating from the Department of Applied Mathematics, University College, London. The methods used are similar to those employed by Prof. Pearson in his "First Study of the Statistics of Pulmonary Tuberculosis" and by Mr. Heron in his "First Study of the Statistics of Insanity," but the data are better in one respect, inasmuch as they are based, not on hospital or asylum cases, but upon information obtained respecting the inmates of convict prisons. Whether, however, such a sample can be correctly described as a random sample of the general population, as the author holds, is certainly open to question.

The conclusions reached by Dr. Goring are confirmatory of those previously put forward by Pearson and by Heron; for both phthisis and insanity he finds a very marked correlation between parents and offspring, the coefficients fluctuating round 0·5. In the case of phthisis no evidence is found of infection between husband and wife, the marital correlation being insignificant and negative. When, however, the author states, arguing against the view that the observed correlation between parent and child may be due to infection, that "upon statistical evidence one conclusion alone seems to follow inevitably and may be asserted without reserve. It is that such parental infection, if existent, is relatively inconsiderable, and that almost the whole of the parental association in phthisis represents an inherited predisposition in the child to be infected with the disease of his parents: that the one vital factor in the occurrence of tuberculosis is inheritance," he makes in the last sentence an assertion which it is a little difficult to excuse. To mention only the best known data, he will find in part ii. of each of the last two decennial supplements published by the Registrar-General ample evidence that the mortality from phthisis is five to ten times as great for persons engaged in certain occupations as for persons engaged in others; it is surely idle, with such evidence at hand, to argue that environmental factors are of no importance!

We do not wish to underrate the value of the memoir—the author deserves the thanks of all those interested in the problem for his reduction and discussion of the data—but we think it should be read with caution, as the writer appears insufficiently acquainted with the other evidence bearing on the question. In conclusion, a doubt may be raised whether the most satisfactory method of studying the influence of heredity on phthisis is to deal as a whole with a random sample of the general population. In view of the widely divergent liabilities of different occupations to phthisis, the heterogeneity of the sample may very well unduly increase the correlations observed.

SOME PAPERS ON AMERICAN ZOOLOGY.

THE mammal and bird fauna of Alaska and Yukon territory forms the subject of No. 30 of the "North American Fauna" (U.S. Department of Agriculture). The author, Mr. W. H. Osgood, gives the results of his observations, both on the nature of the country and the fauna, made during three traverses, namely, one through east central Alaska, a second through the Ogilvie Range of the Yukon, and a third along the course of the Macmillan River. The habits, mutual relationships, and range of the different species form the main subject of the biological section, new names being very few. The attention of sportsmen may be directed to certain observations connected with the habits of moose; but, so far as mammals are concerned, the chief interest in this issue is concentrated in the announcement that the pure white bighorn sheep of the Kenai Peninsula, the so-called *Ovis dalli*, passes by imperceptible gradations into the black sheep (*O. stonei*) of the Stikine Valley. For the future these northern wild sheep must be regarded as local races of the Rocky Mountain Bighorn.

Nos. 1701 and 1702 of the Proceedings of the U.S. National Museum are devoted to the description of portions of the collections obtained during the cruise of the *Albatross* in 1906. In the first of these Miss H. Richardson gives an account of the isopod crustaceans collected in the north-west Pacific. In addition to the new Holotelson—a member of the eubranchiate section distinguished by the emargination of the terminal segment of the abdomen—the author describes a very large number of new species, especially in the genus Arcturus.

Fresh-water sponges from the Philippines form the subject of the second paper (No. 1702). The collection was submitted to Dr. Annandale, of the Indian Museum, who refers some of the specimens to *Spongilla philippinensis*, a species described by himself earlier in the present year, and the rest to a new species, *S. microsclerifera*.

In No. 1703 of the same publication Mr. J. P. Moore describes a collection of polychætous annelids dredged last year off the coasts of Labrador, Newfoundland, and Nova Scotia. Most of the specimens came from Labrador, and all are referred to species already known. They serve to confirm the supposition that the Labrador polychætes would prove to belong mainly to Arctic types, with some admixture from a more southern fauna.

STEAM TURBINES.[1]

IN the first lecture it was pointed out that the first practical steam engine was Newcomen's, about the middle of the eighteenth century, and it used about 20 lb. of coal per horse-power hour. James Watt succeeded in reducing this to 5 lb. or 7 lb. of coal per horse-power hour, chiefly through the introduction of the separate condenser, and the Watt engine remained in principle without other than detail improvements until the gradual rise of steam pressure, and consequent extra expansion, caused compound, triple, and finally quadruple expansion engines to be introduced, and as a result the coal bill is now some one-fifteenth of what it was in the time of Newcomen.

It has, however, been found that with reciprocating engines there must be a steam pressure of about 7 lb. per square inch on the low-pressure piston, or otherwise its size and weight become excessive, and also that there is little or no benefit in going to a higher vacuum than about 25".

With the steam turbine, vacua of 28½" or 29", or absolute pressures of from ¾ lb. to ½ lb. per square inch, can be easily utilised, since the difficulty of dealing with large volumes of steam does not occur in the case of the steam turbine as in the case of the reciprocating engine, and it has been found that with the steam turbine the gain due to vacuum goes steadily on up to the highest attainable vacua. Between 25″ and 26″, or 26″ and 27″, there is a gain of about 4 per cent.; a further gain of 5 per cent. is made with the vacuum increased to 28″, and a still further gain of 6 per cent. to 7 per cent. when it is increased to 29″.

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[1] Abstract of three Cantor lectures delivered before the Royal Society of Arts by Mr. Gerald Stoney, and published in the Journal of the Society for October 8, 15, and 22

This is more easily understood if we consider that the theoretical power to be derived from the steam is almost proportional to the logarithm of the expansions, and thus practically the same power can be obtained working from 400 lb. to 1 lb. absolute, or 28″ vacuum, as from 200 lb. to ½ lb., or 29″ vacuum. In each case there are 400 expansions by pressure, and in each case the theoretical consumption of steam by Clausius' cycle would be about 9·3 lb. per kilowatt hour. With 150° F. superheat this would come down to 8·7 lb., and under the conditions of 200 lb. pressure and 29″ vacuum with 150° F. superheat, 13·2 lb. per kilowatt hour has actually been obtained with an overall efficiency, including the alternator, of about 66 per cent., or 71½ per cent. on the turbine shaft, allowing for the electrical losses. Prof. Ewing, in his book on "The Steam Engine," gives a list of principal results obtained from condensing reciprocating engines, and in no case does the ratio of the consumption of steam by Clausius' cycle, compared with that used per indicated horse-power, exceed 64 per cent. As the ratio of brake horse-power to indicated horse-power is never more than 90 per cent., this means an efficiency at the engine shaft of not more than 58 per cent. When it is remembered that the figure obtained in the case of the turbine was 71½ per cent., and further that the reciprocating engine is unable to take advantage of high vacua, it is easily seen where the advantage of the turbine, especially in large sizes, comes in.

The other advantages were dealt with of absence of vibration, reduced cost of repairs and maintenance, and space occupied, this last being only in some cases one-third or one-fourth of that necessary for reciprocating engines.

In very large sizes, also, it has been found practically impossible to make reciprocating engines satisfactory, and it may not, perhaps, be generally known that one of the reasons which led the Cunard committee to adopt turbines for the great express steamers *Lusitania* and *Mauretania* was the fact that the engineering difficulties of the enormous reciprocating engines required made the problem almost impossible of solution without the use of turbines.

Steam turbines may be divided into two great divisions, single and compound. In the former class there is the De Laval, in which the whole of the expansion is carried out in a single jet, but in order to get efficiency the speed of revolution is so high that gearing has to be resorted to, and this limits this type of turbine to small sizes.

The second class is that universally adopted for all large turbines, in which the expansion of the steam is carried out in stages.

The compound turbine naturally divides itself into two subclasses, those in which the expansion of the steam takes place both in the fixed and moving blades, and those in which it takes place in the fixed blades only. Included in the former class is the Parsons, while the latter contains the Rateau, Zoelly, Curtis, and various others. In the Rateau and Zoelly, which strongly resemble one another, the velocity of the steam at each stage is taken up by a single row of blades mounted on a wheel, and in the Curtis by a wheel having two or more rows of moving blades with guide blades between. There are also various combinations of these, especially those with a Curtis high-pressure part and a Parsons low-pressure, but as yet they have not come largely into use.

A description is then given of the various types of turbine, and also the method of calculating the blading and other particulars, along with some practical rules for their design, and it is shown that, with these limitations, turbines can be constructed with similar stresses and dimensions to give outputs varying as the square of their dimensions and inversely as the square of the speed of revolution.

Now it can be shown that alternators also obey the same rule of varying inversely as the square of the speed, and thus it will be seen that alternators coupled to turbines go up in size together, and that, apart from the trouble there is due to being compelled to have an even number of poles, alternators of the maximum size for that speed have similar turbines attached to them, and thus there is no limit to the size of turbo-alternator. In the case, however, of continuous current dynamos, the output of a dynamo (as it is chiefly limited by commutation conditions which depend principally on the ampere turns on the armature per inch diameter) is practically only proportional to the speed, and it is easily seen that a limit is soon reached where the speed of the turbine is too low for economical conditions.

However, by using tandem dynamos it will be seen that the output is doubled, and this enables tandem turbo-dynamos up to about 4000 kilowatts to be economically built.

In the second lecture various applications of and auxiliaries to the steam turbine were described.

The design of condensers has been especially influenced by the introduction of steam turbines. As has been shown, in the old days of reciprocating engines, the condenser giving 25″ vacuum was quite good enough, but nowadays, on account of the great improvement in economy of steam turbines, with higher vacua, it is common to have between 28″ and 29″.

The maximum vacuum which can be obtained from a condenser is the vacuum due to the temperature of the outlet water, and the closer to this we can get the vacuum actually obtained the better. There are two ways of expressing this difference: one is by pressure and the other is by temperature, and for condenser work the latter is the more convenient. When it is remembered that from about 24″ to 27″ each inch of vacuum makes 4 per cent. difference in the steam consumption of a turbine, between 27″ and 28″ about 5 per cent., and from 28″ to 29″ 6 per cent. or 7 per cent., or that, approximately, 3° F. difference in the temperature of the exhaust means an increase or decrease of about 1 per cent. in steam consumption, it is easily understood how important it is to keep the difference of temperature between the outlet water from the condenser and the temperature due to the vacuum as small as possible. This difference in good modern condensers, when condensing, say, 12 lb. per square foot per hour, can be kept as low as 5° F. or 6° F.

Another way of looking at the efficiency of the condenser is the B.T.U. transmitted per square foot of cooling surface per hour per 1° F. difference of temperature, and this figure can in well-constructed condensers be as high as 1000 to 1200 B.T.U.

It is in connection with the extracting of air thoroughly from the condenser that the greatest improvements have been made of late years, and amongst these dry air pumps and the vacuum augmentor are especially prominent. This latter consists simply of a jet of steam drawing the air and vapour from the condenser and delivering it through a small auxiliary condenser to the air pump, and thus, although the air pump may only produce a vacuum of, say, 27″ or 28″, there may be a vacuum of 28″ to 29″ in the condenser, and in practice this appliance has been found most satisfactory. The effect of using this vacuum augmentor has been in some cases to bring up the conductivity from about 250 or 300 to between 800 and 1000, or to reduce the loss of temperature from some 26° F. to 5° F., a gain in temperature of, say, 21° F., or 7 per cent., in the consumption of the turbine.

When it is remembered that the steam jet of the vacuum augmentor only uses about 0·6 per cent. of the steam used by the turbine, it is easily seen that the gain due to the better vacuum is vastly more than the loss due to the steam jet.

One great field for turbines which has only within the last couple of years come into prominence, although it was patented by Mr. Parsons some years ago, is the use of exhaust turbines, that is, turbines taking steam at atmospheric pressure from reciprocating engines or other machinery, and utilising the power contained in it in an exhaust turbine. When it is remembered that there is as much power in steam working from atmospheric pressure down to a 27″ vacuum as between 150 lb. down to atmospheric pressure, it is easily seen that the power of an existing non-condensing plant can be more than doubled by the simple application of an exhaust steam turbine and condenser. Such installations are now in use all over the country, and from being absolutely a waste product exhaust steam has become a most valuable by-product in many works. In many cases the exhaust steam is intermittent, such as the exhaust steam from a winding engine of a colliery. Such intervals, if not too long, can be bridged over by a thermal accumulator. The principle of thermal storage is itself a comparatively old idea in connection with steam boilers, having been proposed by Druitt Halpin in 1891–2, but the best-known form of accumulator for use in connection with exhaust steam turbines is that of Prof. Rateau, where a tank containing water has the exhaust steam blown through it so that alternately the exhaust steam is partly condensed, and the water in the tank boils, and thus the supply given to the turbine is constant.

In many cases, however, the stops are too long to be bridged over by any form of thermal accumulator, and in such cases what are called "mixed pressure" turbines have been introduced, in which there is a high-pressure part revolving idly when exhaust steam is used, but when the exhaust steam supply fails, by an automatic arrangement this high-pressure part is supplied with live steam, and thus the turbine continues to be driven.

The first applications of the steam turbine to driving machinery were in the driving of electrical machinery, and on land this still continues to be the greatest use for steam turbines, and a full account of turbo-alternators and dynamos is given.

An important development during the past few years has been the application of the steam turbine for driving air compressors. An ordinary steam turbine when driven backwards does not act as an air compressor, but if the blades are suitably shaped it forms a very efficient one, and this fact has led to a large development in the application of steam turbines.

Such turbo-blowing engines are largely used for blast furnaces, the blast pressures required ranging generally from 10 lb. to 16 lb. per square inch.

It may be mentioned that the weight of a turbo-blowing engine complete is 25 tons, and the weight of a reciprocating engine of the same power 430 tons, or seventeen times heavier than the turbine.

For producing pressures higher than 25 lb. per square inch, the design of the blowing engine is usually of the centrifugal type, and consists of a number of centrifugal fans specially constructed to withstand the stresses caused by the high speed of revolution.

In the third lecture an account is given of the greatest development of the steam turbine, that for marine propulsion.

The large and increasing amount of horse-power, and the greater size and speed of the modern engines, tend towards some form which shall be light, capable of perfect balancing, and economical in steam. The marine engine of the piston type does not fulfil these requirements. This led to the well-known *Turbinia* being built, which proved the success of the steam turbine for marine propulsion. After the *Turbinia*, the *Viper* and *Cobra*, torpedo-boat destroyers, followed, but the next great step was the *King Edward*, built in 1902. The arrangement of the turbines was altered considerably from that of the *Turbinia* in order to get increased manœuvring power. Three shafts were still retained, with two screws on the wing shafts and one on the centre shaft, which revolved at rather lower speed; but, instead of all the three turbines being in series, the steam passed first through the centre high-pressure one, and then was divided between two low-pressure turbines, port and starboard. In the same casing as these low-pressure turbines, and at the exhaust end, the stern turbines were incorporated. This gave much better manœuvring power than with the arrangement in the *Turbinia*, as when manœuvring the high-pressure turbine was cut out and steam admitted direct to either or both of the low-pressure turbines or to the astern turbines, thus giving as good manœuvring power as in the case of a twin-screw ship with reciprocating engines.

The success of the *King Edward*, together with that of the *Viper* and *Cobra*, led the Admiralty to have turbines fitted into one of four third-class cruisers, and the vessel chosen was the *Amethyst*. Extensive trials were carried out between her and her sister ship, the *Topaz*, with reciprocating engines, each being 350 feet long and of 3000 tons displacement. The result was that at all speeds above 14 knots the turbine was the more economical, being 15 per cent. better at 18 knots, 31 per cent. better at 20½ knots, and 38 per cent. better at 22·1 knots.

With cross-Channel boats it has been found that the turbine vessels use 25 per cent. less coal per passenger, and travel 2 knots faster, than those with reciprocating engines, and the *Lusitania* has been shown by Sir William White to be 16 per cent. more efficient than the great German reciprocating liners.

The application of the steam turbine to the propulsion of slow-speed ships, that is, ships of below 15 to 18 knots, has up to the present been difficult, owing to the low speed of revolution of the screws making the turbines large and heavy, as well as not economical. This difficulty has now been got over by the use of an arrangement patented by Mr. Parsons some years ago, viz. the combination of reciprocating engines and exhaust turbines, similar to what was described before for land work. Here each utilises the part of the expansion for which it is best suited—the reciprocating engine for the high-pressure part of the range and the turbine for the low-pressure where the volume of steam is large.

It is interesting to note that in the early days of the screw propeller the great difficulty was to make the engines run fast enough for the screw, and spur gearing was adopted in many cases in the first half of the last century. Gearing has been entirely dropped for the last fifty or sixty years, but now the difficulty in many cases is to make the turbine run slow enough for the screw, and once more gearing is being considered so as to make the turbine adaptable for use in slow-speed steamers, which, after all, constitute by far the greater part of the shipping of the world.

The combination system described above does this, but gearing a high-speed turbine to a slow-speed screw would also accomplish what is needed.

Eighty years ago there was nothing but primitive spur gearing, with generally wooden teeth in one member, but now we have steel gears accurately cut by modern machinery, often with helical teeth, and running in oil baths.

At the present date there are about 120 vessels actually on service fitted with turbines, representing about 1,250,000 horse-power, and these comprise practically all the high-speed ships which have been recently built. Some seventy more are under construction, representing another 1,000,000 horse-power, or a total of 2,250,000 horse-power, and the curve of progress as yet shows no sign of saturation.

THE OUTLOOK OF SCIENCE.[1]

PROBABLY there never was a time when the scientific spirit was more active than at the present moment. We see evidence of this on all hands. In the realms of abstract science we have researches dealing with profound questions as to the intimate nature of matter that were not within the sphere of thought only a few years ago. The theories of electrons which are founded on mathematical and physical investigation give us a glimpse into worlds of movement of which those before us had no conception, and of stores of energy that may one day be liberated in the service of mankind. That mysterious agency, electricity, is now seen to be probably at the basis of all phenomena, physical, chemical, vital, and a new interpretation is given of many actions going on all around us. The relation of matter to the circumambient æther also engages the speculations of men of science.

Researches at extremely low temperatures, down near to absolute zero, as carried out by Dewar, are enabling the physicist and chemist to criticise the properties of matter from a new point of view. The microscope, hitherto an instrument used mostly by the biologist, is now employed in the investigation of the molecular structure of metals and other substances, as these are modified by pressure and strain. The phenomena of radio-activity have opened up a new world, and no achievement of science is, to my mind, more wonderful than the way in which a modern physicist can measure the velocity and count the number of inconceivably minute particles that fly off from a morsel of radio-active matter.

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[1] From an address delivered to the associates and students of the Glasgow and West of Scotland Technical College on October 28 by Prof. John G. McKendrick, F.R.S.

For many purposes the steam engine has been outdistanced. The energy now available from modern engines is much greater than was at one time thought practicable. The best triple-expansion steam engines gave back as mechanical energy only 17 per cent. or 18 per cent. of the energy represented by the combustion of the fuel, the remaining 82 per cent. and 83 per cent. being lost, or, at all events, is mechanically inefficient, as heat. A human muscle gives as mechanical energy 25 per cent. of the energy of the food, but the remaining 75 per cent. of heat is necessary for the life of the muscle, so that, in this aspect, it is superior to the steam engine.

I have often been struck with the wonderful economy of nature. She attains her ends usually by the simplest and most direct method and with the smallest expenditure of matter and energy, and one cannot help thinking that future inventions—I mean inventions during the next two or three centuries—will be in this direction. The electric organ of an electric eel, at rest, may show so small an electromotive force as to require a good galvanometer to detect it, but a nervous impulse from nerve-cells in its spinal cord may suddenly raise a potential of many volts, and this with little heat and with so small an expenditure of matter as to defy the most expert chemist to weigh it. The electric organ is in no sense a storage battery, but rather a contrivance by which electrical energy is liberated at the moment it is required. The fire-flies, the glow-worms, and many deep-sea fishes can produce light without heat and at a cost which would make the price of a wax vesta an extravagant outlay. Plants, possibly aided by micro-organisms, or at all events by ferments (enzymes), can produce alkaloidal substances at a low temperature and by slow processes; but, on the other hand, to produce these synthetically the organic chemist requires all the resources of his laboratory, high temperatures, acids, and other potent agencies. Many other examples might be given of the economy of nature all establishing the truth that the principle of least action holds good everywhere—a principle which some have thought was a greater, at all events a wider, generalisation than that of the conservation of energy.

There is another department of science to which I must refer in this brief survey. I refer to bacteriology, a branch which deals with the life-history of minute organisms that play a very important part in the economy of nature. In the public mind there is a widespread impression that bacteria and other organisms are the enemies of man, but this is far from being the case with the great majority of these humble plants. Of the thousand or fifteen hundred species now known, probably only fifty or so are inimical to men. The others are highly beneficent. Some are engaged in taking nitrogen from the air for the use of the higher plants: others in splitting up complex substances existing in the bodies of dead plants and of dead animals, and in restoring simpler substances to the soil: others purify our rivers and lakes; even the ocean is the theatre of their activities: and others have to do with the varied phenomena of fermentation. A knowledge of the life-history of these microbes has enabled the physician and surgeon not only to do much in the way of preventive medicine, but to benefit mankind in the treatment of many diseases; and, what is probably of even greater interest, we now recognise that the *rôle* played by these living beings is of the greatest importance in many industries. Such are the industries connected with fermentations, brewing, distilling, baking; the processes of the dairy, as in butter-making and cheese-making; and the important industry of tanning or making leather. In those industries and in scientific agriculture the services of microbes are being more and more called to our aid. Bacteriologists can now make pure cultures of micro-organisms that are useful, and practical men may sow these in approximate media where they do their useful work. In this way the soil of the farmer may be enriched, the growth of particular cereals, leguminous plants, and roots may be facilitated, and the products of the dairy may be made more wholesome. There can be no doubt that in the future many industrial processes, such as these of tanning, paper-making, and others, will be improved as we are able to call these humble beings to our assistance. This, I think, is one of the fairy tales of scientific achievement.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Mr. W. G. Fearnsides has been appointed demonstrator of petrology, and Mr. F. J. M. Stratton assistant in astrophysics.

Mr. E. M. Wellisch has been elected to the Clerk Maxwell scholarship.

The general board of studies recommends that Mr. K. J. J. Mackenzie be appointed as university lecturer in agriculture for five years, and that he receive a stipend of 200*l.* a year, payable out of the agricultural education fund.

Dr. Stein will deliver a lecture in Cambridge on Thursday, January 20, at 5 p.m., on his explorations in Asia.

London.—A new syllabus in chemistry is to come into force at the matriculation examination on and after January, 1911. In the new syllabus greater emphasis is attached to the theoretical basis of the science and to physical phenomena, such as the development of heat in chemical reaction. The general characteristics of the metals, including an elementary study of sodium, calcium, and iron, and their common compounds, are introduced, while the elementary organic chemistry and a part of what was termed the "chemistry of common life" has been taken out of the syllabus.

Oxford.—The news of the impending retirement of Dr. E. B. Tylor, F.R.S., professor of anthropology, will be received with universal regret. It is perhaps not easy for the present generation to realise how much the science of anthropology owes to the unwearied labours of Prof. Tylor, continued for the space of full fifty years. The importance which the subject has now attained among the studies of Oxford is in large measure due to the energy and enthusiasm with which, on his appointment in 1883 as keeper of the university museum, and afterwards as reader and professor, Dr. Tylor threw himself into the work of arousing and maintaining interest in the scientific history of the arts and institutions of mankind. Under his careful management, and with the able help of the curator of the splendid Pitt-Rivers collection, Mr. H. Balfour, and of other younger workers, the study of anthropology in Oxford has during the last quarter of a century been completely transformed. Prof. Tylor's kindliness and geniality have secured to him the affection of a large circle of friends, whose good wishes will follow him into his retirement.

The second annual dinner of the Old Students' Association of the Royal College of Science will be held on Friday, January 7, 1910. Tickets may be obtained from the secretary of the association, Mr. T. L. Humberstone, 3 Selwood Place, South Kensington. Sir Thomas H. Holland, K.C.I.E., F.R.S., has consented to nomination as president of the association for the year 1910, in succession to Mr. H. G. Wells.

Speaking at the Strand School, King's College, on December 10, Sir William White said that it is not putting a narrow or improper meaning on the word "education" to say that it must have relation, in the case of the vast majority of men and women, to their getting a livelihood. An examination which is passed by means of cramming is mischievous. In many cases boys crammed for an examination have obtained for themselves positions for which they are totally unfitted. Some men spoil their lives by cramming for examinations; they take away all the freshness of life by simply accumulating different kinds of knowledge for reproduction in a match against time. On the other hand, there are many excellent men who, directly they get into the examination room, can never do themselves justice. Examinations, therefore, do not always find out the best men; but in the circumstances of the present time it seems impossible to find a substitute.

A Reuter message from Brisbane states that the ceremony of the dedication of Government House buildings as the home of Queensland University was performed on December 10 by Sir W. MacGregor, the Governor of Queensland. Sir W. MacGregor read a message from the King congratulating the people of Queensland and expressing the hope that the enterprise and loyalty which have marked the first fifty years of the existence of Queensland may be an abiding heritage, and that the prosperity of the State will be multiplied abundantly in years to come. The Governor said that he was gratified at participating in a gathering of such importance, establishing as it did the corner-stone of a system of State education. In no other country can the pursuits of professional and economic life be followed to greater advantage than in Queensland, which has an extraordinary multiplicity of resources. The university course includes arts, without unduly encroaching upon more modern developments of direct utility. The plan of the University is an elastic one, and capable of unlimited expansion. Sir W. MacGregor assented, on behalf of the King, to the University Bill, and unveiled a tablet dedicating the building. The gift was accepted on behalf of the people by Mr. Bell, the Speaker of the Legislative Assembly. Speeches were also delivered by Profs. David, of Sydney, and Stirling, of Adelaide Universities. Mr. Kidston announced that 50,000*l.* has been set aside for initial expenditure and 10,000*l.* annually for working expenses, and there will be sixty foundation scholarships.

A recent report to the Middlesex Education Committee by its secretary and inspector of schools provides particulars concerning an experiment in operation in Strassburg on employment bureaux for children of school-leaving age. In Strassburg the education authorities work in conjunction with the labour bureaux and the employers. A card is handed to the child on leaving school, which, when filled up, contains all particulars necessary for intending employers. This information is supplied by the parents, the headmaster, and the medical officer. It is obvious that little can be done without the cooperation of employers of labour. Most Strassburg employers now prefer to engage a boy through the bureau, as they are able at a glance to obtain a fair estimate of his capabilities from trustworthy sources, and are in this way safeguarded from employing one who may be unequal to the work required. When a boy is engaged the date is noted, and a record of his career as an employee is kept by the bureau, and this is of great benefit to future employers. The success of this scheme has justified the experiment. Every year a large percentage of children of both sexes find suitable employment in this way. Parents, employers, teachers, and apprentices all speak highly of the scheme. The bureau does not confine its attention to children only, but deals with adults, and is part of a widely spread system, with branches in many parts of Germany as well as in other European countries, and has enabled the authorities to find employment for a large percentage of applicants. The bureau being in direct telephonic communication with every other centre, an applicant is found work in the shortest possible time. With a complete record of a man's career there is little risk of imposture, and no hesitation is made in advancing the railway fare to his work in other towns when necessary.

The prizes and certificates at the Northampton Polytechnic Institute were distributed on December 10 by Sir John Wolfe-Barry, K.C.B., who in the course of his address spoke of technical education as scientific instruction in the useful arts. It was not, he remarked, until about 1870 that we began to realise that all was not well with the trade of England and with English methods. At that period primary education was at a very low ebb, and scientific education was in the possession of very few. Technical education for the masses was unknown, and was scarcely desired. The late Prince Consort played a prominent part in rousing the country to the necessity of altering its methods and fostering technical education. In 1877 the City and Guilds of London Institute led the way in a systematic manner in developing the new movement. Since they put their hands to the plough they have spent 800,000*l.* of their own property, and are still spending at the rate of from 23,000*l.* to 25,000*l.* a year in developing the movement which they set on foot more than thirty years ago, which has materialised into the Central Technical College at South Kensington, the Finsbury Technical Institute, and their art school at Kennington. Turning to the work of the Northampton Polytechnic Institute, Sir John Wolfe-Barry gave the history of its development from its initiation some fifteen years ago. After referring to the assistance given by the City Parochial Foundation, the Skinners' Company, and the Saddlers' Company, he emphasised the debt which it owes to the London County Council. Dealing specially with the subject of technical optics, he expressed the hope that the much delayed development would be proceeded with before another year had passed, for such development would deal with an important branch of a scientific trade, and a trade in which we ought more than to hold our own with foreign competitors. Returning to the general subject of technical education, he indicated its limitations, and showed how one of its chief objects is to enlarge the army of scientific workers, and thus to enlarge the area from which the leaders and generals of industrial life are to be drawn, tending thus to substitute intelligent methods for the rule of thumb and to make man less and less an animated machine. Technical instruction, he concluded, must follow the abstract sciences, and not attempt to limit them. In the course of the evening the head of the mechanical engineering department, Mr. C. E. Larard, gave a lecture on the twisting of materials to destruction. He directed attention to a remarkable testing machine which has been installed in his department, and embodied in his lecture the results of his researches on the behaviour of various qualities of steel when twisted to destruction. By means of this machine specimens of steel up to $3\frac{1}{2}$ inches in diameter can readily be twisted to destruction.

SOCIETIES AND ACADEMIES.

London.

Geological Society, December 1.—Prof. W. J. Sollas, F.R.S., president, in the chair.—W. G. **Fearnsides**: The Tremadoc slates and associated rocks of south-east Carnarvonshire. Results obtained in making a detailed map of the country about Portmadoc, Tremadoc, and Criccieth in Carnarvonshire, and a description of the stratigraphy of the Cambrian and Ordovician rocks there exposed. The sedimentary series are described in the order of their formation. The succession is tabulated. The folding, cleavage, faulting, and jointing of the rocks are described, and an attempt is made to show some relationship between the stress-phenomena which have produced these structures. The great fault through Penmorfa is interpreted as a thrust-plane hading gently to the north-east. It is supposed to form the lowest sole of the group of thrust-planes which follow the southern margin of the Snowdonian mountain-tract. The well-known pisolitic iron ore of Tremadoc is shown to follow the line of this fault. Direct evidence of overthrusting has been got from a study of the graptolite-bearing Llandeilo rocks of Tyddyndicwm, which have been exposed in two artificial trenches dug for the purpose, and the distribution of the andesitic volcanic series in lines of detached lenticles among the Grey Slates is described as evidence of a similar re-duplication of the newer rock-series of the north-eastern district on a more extended scale. It is noted that the dolerites are (1) unaffected by cleavage and faulting, and (2) have metamorphosed rocks which were already cleaved, cut, and re-duplicated by the thrust-faulting at the time of their intrusion. The Glacial and post-Glacial accumulations are also described in outline.—E. S. **Cobbold**: Some small trilobites from the Cambrian rocks of Comley (Shropshire). Most of the trilobites were obtained during the progress of the excavations referred to in the report of the Geological Excavations Committee of the British Association, read at the Dublin meeting, 1908. The specimens were derived from the Olenellus Limestone of Comley, and from the Grey Limestones which intervene between that horizon and the Conglomeratic Grit, yielding a Paradoxides fauna.—J. B. **Scrivenor**: The rocks of Pulau Ubin and Pulau Nanas (Singapore). Pulau Ubin and Pulau Nanas are islands set in the eastern entrance to the Straits of Johore, and consist of igneous rocks of considerable interest. Pulau Ubin is composed mainly of hornblende-granite, but a pyroxene-bearing microgranite is found also, while the hornblende-granite is cut by rhombic-pyroxene bearing veins and also contains angular masses of rock resembling the veins. Pulau Nanas consists of dacite-tuffs and dacite, which are referred to the Pahang volcanic series, of Carboniferous or Permo-Carboniferous age. The tuffs and lavas have been altered by the adjacent granite of Pulau Ubin, and contain much secondary biotite and hornblende; their most remarkable feature is the presence of fragments of altered granite. The mutual relations of the different rocks are described. The normal granite of Pulau Ubin is hornblende-granite, the age of which is certainly post-Triassic and pre-Eocene, perhaps post-Inferior-Oolite and pre-Cretaceous. Veins of quartz-norite and masses of quartz-biotite-gabbro, and veins and masses of a fine-grained rock which may be described as enstatite-spessartite, are found in the normal granite of Pulau Ubin. A pyroxene-micro-granite and porphyry on Pulau Ubin, and a rock at Changi, having the mineral constitution of an amphibole-vogesite, are described. The dacite-tuffs of Pulau Nanas contain fragments of granite which must be of pre-Carboniferous age, and are referable to the granite of Amboyna. The fragments of granite, and perhaps certain pebbles of schorl-rock, are the only evidence found as yet in the Malay Peninsula of pre-Carboniferous rocks.—J. B. **Scrivenor**: The tourmaline-corundum rocks of Kinta (Federated Malay States). Overlying the limestone on the west side of the Kinta Valley is a thin cap of schists, with which are found certain rocks, the two chief constituents of which are tourmaline and corundum. They are often carbonaceous, and, in the many variations found, white mica, brown mica, pleonaste, rutile, and metallic sulphides occur. The tourmaline-corundum rocks of Kinta consist of varying amounts of tourmaline, corundum, carbon, white mica, spinel, and other minerals. They contain cavities about 6 millimetres in greatest width, generally bordered by a layer of corundum grains, with tourmaline grains on the inside of this border. Sometimes solid bodies similar in size and shape to the cavities occur. Smaller bodies occur, sometimes, but not always, accompanied by the larger cavities and bodies. They consist of tourmaline, of corundum, and of tourmaline and corundum. When both minerals are present the corundum forms a shell to a nucleus of tourmaline. The tourmaline-corundum rocks are associated with other rocks, which lead to the conclusion that the structures described are the result of replacement of the materials of preexisting bodies at the time of extensive granitic intrusions. They also are associated with rocks which point to the original beds having been laid down under conditions similar to those that obtained when the Pahang chert series was deposited. As tourmaline-bearing partings in the limestone at Changkat Pari constitute a case of selective metamorphism, so it is thought that the tourmaline-corundum rocks mark a process of intense metamorphism in beds associated with schists. These beds were probably chert and silicified limestone, both being in many cases carbonaceous. The larger cavities and bodies mentioned are believed to be the result of replacement of oolitic grains. The smaller bodies may be, in part, the result of replacement of the materials forming casts of radiolarian structures.

Mathematical Society, December 9.—Sir W. D. Niven, president, in the chair.—T. H. **Blakesley**: An instrument for the kinematical solution of cubic equations.—A. L. **Dixon**: The eliminant of the equations of four quadric surfaces.

Cambridge.

Philosophical Society, November 22.—Prof. W. Bateson, F.R.S., president, in the chair.—J. C. F. **Fryer**: Aldabra and neighbouring islands.—Prof. Stanley **Gardiner**: Western Indian Ocean.—D. G. **Lillie**: Notes on the larger Cetacea. It is pointed out that whaling stations have been recently established off the shores of Ireland and Scotland which offer exceptional opportunities for a study of the larger Cetacea. The history of the whaling industry is briefly traced, and a short account given of the modern methods of whaling from notes taken during a visit to the Irish station. The paper also contains a note on the occurrence of hairs in whales. Hairs appear to be absent in Odontocetes. The distribution of hairs in two species of Balænoptera is described, and a reason suggested for the occurrence of hairs in the Mystacoceti.—G. N. **Watson**: The continuations of functions defined by generalised hypergeometric series.—L. **Vegard**: Some general properties of mixed solutions.

Manchester.

Literary and Philosophical Society, November 30.—Mr. Francis Jones, president, in the chair.—Prof. E. **Rutherford**: The action of the α rays on glass. The author recently reproduced the conditions under which pleochroic halos, such as have been observed in mica, would be formed, by enclosing a large quantity of radium emanation in a fine capillary tube of soda glass. When looked at under the microscope the walls of the tube were seen to be surrounded by a well-defined halo about 0·4 mm. in depth, which was equivalent to the maximum distance of the α particle from the active matter. This result confirms the correctness of the explanation given by Joly of haloes in mica, as being due to small inclusions of radio-active material.—Dr. B. B. **Boltwood** and Prof. **Rutherford**: Production of helium by radium. After mentioning that Rutherford, Geiger, and Royds had shown that the α particle was an atom of helium, and that Rutherford and Geiger had also calculated, by counting the α particles, that 1 gram of radium in equilibrium should produce 158 cubic mm. of helium per year, the authors state that they have recently made a determination of the rate of production of helium by actually measuring the volume produced. They used a barium-radium salt containing about 200 milligrams of radium, loaned to one of them by the Vienna Academy of Sciences. The experiments gave a result corresponding to the production of helium at the rate of 163 cubic mm. per gram of radium per year. Sir James Dewar last year made systematic measurements which indicated that helium was produced at a constant rate equivalent to 135 cubic mm. per gram of radium per year.—Dr. A. N. **Meldrum**: Development of the atomic theory, i., Berthollet's doctrine of variable proportions. The controversy between Berthollet and Proust at the beginning of the nineteenth century as to whether the composition of chemical substances is variable or not has been greatly misunderstood. The histories of chemistry represent Berthollet as a "person who had preposterous notions" about the composition of chemical substances, and was "deservedly annihilated" by Proust. A study of the period shows that Berthollet's teaching, having easily survived the criticisms of Proust, was refuted by Dalton's teaching, and that the doctrine of fixed proportions was only then put on a sound basis.

Paris.

Academy of Sciences. December 6.—M. Bouchard in the chair.—The number of foreign associates has been increased from eight to twelve.—H. **Poincaré**: Curves traced on algebraic surfaces.—T. **Carpentier**: Remarks on an isothermal barometer invented by the Marquis de Montrichard.—C. **Guichard**: Surfaces such that the tangents to a series of lines of curvature touch a quadric.—D. **Cirera**: The magnetic disturbance of September 25, 1909. Details of observations made at the Observatory of Ebro. —J. Comas **Sola**: *Résumé* of observations of Mars, made at the Fabra Observatory, Barcelona, during the opposition of 1909. These observations were made with the double Mailhat equatorial of 38-cm. aperture, the atmospheric conditions in October being extremely good. The main topographical details of Mars are invariable, but this is not the case with the smaller details. A diagram of a portion of the planet accompanies the paper.—Ch. **Nordmann**: A new approximation in the study of the effective temperatures of the stars. These results are based on the application of Planck's radiation law to the spectrophotometrical measurements described in an earlier paper. The temperatures found range from 2870° for ρ Perseus, 5320° for the sun, to δ Perseus 18,500°, and λ Taurus more than

40,000°.—M. **Maneng**: Observations of a small planet, probably new. The elements have been determined from photographs taken by M. Boinot on October 19 and 23.—M. **Tilho**: The precision of determinations of longitude on land by the chronometer, according to observations by the Niger-Tchad expedition. A comparison of the results obtained for differences of longitude by the telegraph, direct-length measurement, and the chronometer show that the last-named agrees very satisfactorily with the other methods.—Eugène **Fabry**: The order of a Taylor's series.—M. **Galbrun**: The representation of the solution of an equation of finite differences for large values of the variable.—Arnaud **Denjoy**: Completely discontinuous ensembles.—D. **Pompéiu**: Discontinuous singularities of uniform analytical functions.—J. **Haag**: Families of Lamé composed of helicoids.—René **Garnier**: Surfaces of the fourth order which admit of an infinite discontinuous group of birational transformations.—L. **Remy**: The birational transformations of surfaces of the fourth order with doubly isolated points.—M. **Ravigneaux**: The generalisation of the formula of Willis on epicycloidal trains.—Hector **Pécheux**: The electrical properties of steels. Measurements are given of the resistances at various temperatures and thermoelectromotive forces (against copper) of four steels, ranging in quality from very soft to hard.—André **Léauté**: The mathematical study of the heating of a conductor traversed by a very rapid oscillatory discharge.—C. E. **Guye** and V. **Freedericksz**: The internal friction of solids at low temperatures. Studies of the torsion of wires of silver, aluminium, gold, magnesium, iron, and quartz at temperatures between 100° C. and −196° C.—H. **Baubigny**: The estimation of dithionic acid and the dithionates. Accurate results were obtained only by the dry method, fusion with a mixture of alkaline carbonate and nitrate.—Marcel **Delépine**: The chloroiridates and chloroiridites of silver and thallium.—G. D. **Hinrichs**: The calculation of atomic weights: the solution of the equation of condition.—A. **Colson**: The reduction of sodium sulphate by carbon. A mixture of lampblack and sodium sulphate reacts rapidly at 950° C., 70 per cent. of the sulphate being decomposed in twenty minutes.—J. A. **Muller**: The phase rule. A reply to the criticism of M. Boulouch.—G. **Leser**: The two isomeric hexamethylene β-diketones.—H. **Arsandaux**: Contribution to the study of lateritic formations.—A. **Maige**: The formation of heterotypical chromosomes in *Asphodelus microcarpus*.—G. **Perrin**: Fertilisation in the prothallus of *Pteris tremula*.—J. **Dumont**: The layers surrounding earthy particles. Sand grains separated from soil by simple levigation are generally coated with a colloidal layer, removable by solutions of oxalic acid. The amount of this layer is shown to depend on the size of the particles.—G. **Grandidier**: The description of a new bird, *Monias benschi*, from Madagascar.—Louis **Roule**: Amphibians of the genus Euproctus.—B. **Collin**: Preliminary diagnoses of some new or badly known Acinetæ.—L. **Cayeux**: The secondary quartz of the Silurian oolitic iron minerals of France, and its replacement in the lower layers by iron carbonate.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 16.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Some Quantitative Measurements in Connection with Radio-telegraphy: Dr. J. A. Fleming, F.R.S.—Efficiency of Short Spark Methods of Generating Electrical Oscillations: Dr. W. H. Eccles and A. J. Makower.

LINNEAN SOCIETY, at 8.—Report on the Crustacea Isopoda and Tanaidacea collected by Mr. C. Crossland in the Sudanese Red Sea: Rev. T. R. R. Stebbing, F.R.S.—Pycnogonida from the Red Sea and Indian Ocean collected by Mr. C. Crossland: Prof. G. H. Carpenter.—On a Collection of Blattidæ preserved in Amber from Prussia: R. Shelford.—Isopoda from the Indian Ocean and British East Africa: Rev. T. R. R. Stebbing, F.R.S.—The Bryozoa from Collections made by Mr. C. Crossland, Part II., Cyclostomata, Ctenostomata, Endoprocta: A. W. Waters.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, DECEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Mild-steel Tubes in Compression and under Combined Stress: W. Mason.—Compound Stress Experiments: C. A. M. Smith.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Foundation and Construction of Dock Walls: H. T. Tudsbery.

MONDAY, DECEMBER 20.

ROYAL SOCIETY OF ARTS, at 8.—Aëronautics: C. C. Turner.

INSTITUTE OF ACTUARIES, at 5.—On the Mortality of Female Assured Lives, with Graduated Tables deduced from the British Offices' Experience, 1863-1893: C. W. Kenchington.

TUESDAY, DECEMBER 21.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Railway-Signalling in India: C. W. Hodson.—*Probable Paper*: The Design of Rolling Stock for Smooth-rail Working on Heavy Gradients: F. W. Bach.

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THURSDAY, DECEMBER 23, 1909.

THE CAMBRIDGE NATURAL HISTORY.

The Cambridge Natural History. Vol. iv., Crustacea, by G. Smith and the late W. F. R. Weldon; Trilobites, by H. Woods; Introduction to Arachnida, and King-Crabs, by A. E. Shipley; Eurypterida, by H. Woods; Scorpions, Spiders, Mites, Ticks, &c., by C. Warburton; Tardigrada (Water-Bears), by A. E. Shipley; Pentastomida, by A. E. Shipley; Pycnogonida, by Prof. D'Arcy W. Thompson. Pp. xviii+566. (London: Macmillan and Co., Ltd., 1909.) Price 17*s.* net.

WITH the present volume, the last to be issued of the ten volumes forming the Cambridge Natural History, that carefully planned and well-executed work is completed. The editors, Dr. S. F. Harmer and Mr. A. E. Shipley, are to be congratulated upon having brought their enterprise to a satisfactory conclusion, and upon having placed at the disposal of advanced students of zoology, both professional and amateur, an authoritative account of each of the principal phyla of the animal kingdom.

The section on the Crustacea had been entrusted to the late Prof. Weldon, and the one chapter dealing with the Branchiopoda, which he had completed before his death, is so clearly the work of a master-craftsman that it is hardly possible not to feel a sense of regret that he was unable to finish the task so well begun, and not to realise dimly what an original and valuable contribution to crustacean literature his completed work might have been. Prof. Weldon's pupil, Mr. Geoffrey Smith, was placed at a disadvantage in having to continue this work at short notice and under pressure of time, and it was not to be expected that he would be able to carry it on upon the same lines as those on which it had been begun. Where he is speaking of matters with which his own researches have given him knowledge at first hand, Mr. Smith had done excellently. Thus there is a very careful account of the order Anaspidacea, and an even more interesting and suggestive section on the parasitic cirripedes Peltogaster and Sacculina, which infest other Crustacea. Other portions of the section, which are clearly compiled from the literature, are, unfortunately, not so satisfactory, and there is great lack of a due sense of proportion in dealing with many groups. Thus the interesting order Cumacea is dismissed in about a page and a half, and the information which is given is so summarised as to be of little value. It cannot but be a matter for regret, also, that in a work of this character on the Crustacea so little attention has been paid to internal anatomy. It is true that much investigation is still necessary before a really adequate account of the morphology of the internal organs in this group can be compiled, but at the same time a very large literature dealing with the subject already exists which has been only very lightly dealt with.

Mr. Henry Woods contributes to the volume a clear and well-illustrated account of the Trilobites. He takes the view that their affinities are with the Crustacea, more particularly with the Phyllopoda, and recognises sixteen families. He is unable, however, to accept either Salter's classification of the families into four groups, or the modification of that classification proposed by Beecher.

The principal chapters on arachnids are by Mr. Cecil Warburton, who has written a very valuable treatise on this group. Mr. Warburton's work is to be especially commended in that he has done such full justice to all aspects of his subject. The anatomy and morphology of scorpions, spiders, and mites are dealt with authoritatively and with great accuracy of detail, whilst at the same time that side of the subject which results from the work and observations of the field naturalist is treated in an equally satisfactory way. Chapter xiv., dealing with the habits of spiders, is, indeed, one of the most interesting in the whole series of volumes of the Cambridge Natural History. The subject is a fascinating one in itself, and the author has, by a judicious introduction of his own personal observations on familiar British species, given to it an air of reality which adds greatly to the pleasure of the reader and to the value of the information given.

Chapters on the king-crabs (Xiphosura) and on Tardigrada (water-bears) and Pentastomida are added by Dr. A. E. Shipley. With regard to the affinities of the latter group of parasites, in which the structure is obviously much modified, the author does not commit himself to any very definite opinion, but contents himself with referring, in somewhat general terms, to those characters which they possess in common with some arachnids. A useful list is given of all the known species, with their primary and secondary hosts.

The concluding chapter of the volume is by Prof. D'Arcy Thompson, and deals with the Pycnogonida. Prof. Thompson writes with somewhat greater elaboration of literary style than is generally adopted by present-day scientific authors, but whether always with happy results we are inclined to doubt. Thus the chapter opens with this sentence:—

> "Remote, so far as we at present see, from all other Arthropods, while yet manifesting the most patent features of the Arthropod type, the Pycnogons constitute a little group, easily recognised and characterised, abundant and omnipresent in the sea."

The enthusiasm of the last clause of this sentence would, we fear, be somewhat damped by a sudden call to find, say, fifty living specimens in any but some specially favoured locality.

The chapter is, however, taken as a whole, clear and accurate, and is certainly the best account of the pycnogonids available for English students. With regard to classification, Prof. Thompson considers that Decolopoda is probably the most primitive form known, and that Colossendeis is closely allied to it. The Eurycydidæ and Ammotheidæ are allied to Colossendeis, whilst the true position of Rhynchothorax is very doubtful. On the other hand, the Nymphonidæ, in which is included the five-legged Pentanymphon, described by Hodgson from the Antarctic, also show a minimum of degeneration, and must, therefore, also be regarded as primitive, though separated from Decolopoda by many differences. The Pallenidæ are closely allied to the Nymphonidæ. The Phoxichilidiidæ have points of resemblance with the Pallenidæ, and the Pycnogonidæ are probably allied to them. The ideas here expressed as to the relations of the different families have, however, recently been questioned by Carpenter, whose views have received support from Calman. According to these authors, the fifth pair of legs in Decolopoda and in Pentanymphon may possibly represent a comparatively new development and not a primitive character.

MORTALITY TABLES.

The Theory of the Construction of Tables of Mortality and of Similar Statistical Tables in Use by the Actuary. A course of lectures delivered at the Institute of Actuaries, Staple Inn Hall, during the Session 1904–5, by G. F. Hardy. Pp. iii+141. (London: C. and E. Layton, 1909.) Price 7s. 6d.

THIS course of lectures, which was delivered under the auspices of the Institute of Actuaries, deals with the construction of mortality and similar tables which, as the author justly observes in his opening sentence, lie at the very basis of actuarial work. They deal succinctly with familiar methods of graduation, such as the graphic and Woolhouse's difference method, but are for the most part devoted to more modern theories of curve-fitting, and to the application of Makeham's hypothesis in dealing with the somewhat intractable curve which arises from the fact that, with assured lives, the rate of mortality is for several years a function of time that has elapsed since medical examination rather than of age.

It may be remarked that a subject involving much technical mathematical detail cannot be satisfactorily dealt with in the form of lectures. Mr. Hardy's first two lectures deal with methods of graduation which are familiar to most actuaries, and can be suitably presented in this form, but the remaining four lectures contain much original work, which can only be thoroughly understood after careful reading and study. Fortunately, Mr. Hardy appears to have realised the limitations of his medium, and in its present form the work is well suited to the actuarial student.

The publication of this book is of special interest, as a perusal of it shows that modern development in the graduation of tables of mortality has, singularly enough, had its impulse and inspiration from outside the actuarial profession. To Prof. Karl Pearson's original work in the field of biological statistics, actuaries are indebted for the new calculus, which was applied by Mr. Hardy in the graduation of the principal mortality tables compiled from the experience of lives assured in British offices, and published a few years ago. Actuaries, indeed, cannot be said to have taken very readily to the new method, and during the last three years there has been a surprising number of contributions in the Journal of the Institute of Actuaries dealing with the development of those finite difference formulas to which Mr. Hardy devotes only half-a-dozen pages in this book, and which will, we hope, in a few years be considered obsolete.

The most interesting part of the book is that dealing with the Pearsonian frequency curves, and it is suggestive of the exhaustive nature of the work done by Prof. Pearson to find that so original a thinker as Mr. Hardy has practically nothing to add to the information we have already received about this important family of curves. He, in fact, refers the reader to Prof. Pearson's works, and to the treatise of Mr. W. Palin Elderton, for fuller information. The latter work was published only three years ago for the benefit of actuaries, and will, we think, hold the field as the only text-book on the subject for some years. In these circumstances, it may perhaps be regretted that Mr. Hardy has seen fit to re-number the types of curves, as this may easily confuse anyone who finds occasion for reference to both books, or to Pearson's original work, which Elderton follows. The student will also be in difficulty at the outset owing to Mr. Hardy giving the differential equation from which these curves are derived as

$$\frac{1}{y}\cdot\frac{dy}{dx}=\frac{bx-x^2}{a-bx-cx^2},$$

instead of the one to which we are accustomed,

$$\frac{1}{y}\cdot\frac{dy}{dx}=\frac{x+a}{b_0+b_1x+b_2x^2+\ldots},$$

and we may mention that a misprint would appear to have been introduced here, as it does not seem possible to derive Pearson's Type I. from the first-mentioned equation.

It is unfortunate that Mr. Hardy has not illustrated this part of his subject by reference to the chief mortality table, in the graduation of which the method of frequency curves has been employed, and was carried out by himself. When it is remembered that this will now be the standard mortality table for many life-insurance purposes, it seems strange that so favourable an opportunity should have been missed.

In justice, however, to the author, it may be as well to say that, taking into consideration the space at his disposal, he has done wisely in devoting so large a proportion of it to the study of the Makeham curves, in the knowledge and manipulation of which he is so able an exponent. At the second International Congress of Actuaries, one of the most eminent of Continental actuaries stated that, in his opinion, the day had entirely gone past in which Makeham's graduation would be practically applied in the graduation of tables; and it is a singular commentary on this statement that the select annuity and assurance tables of the recent experience have been graduated by the application of the formula in question. In order to prove the importance of this matter to actuaries, it is only necessary to point out that the value of an annuity payable during the joint life of two persons of any age can be found from a table giving the annuity values for two lives of equal age, whereas, in the case of a table graduated on different principles, a large volume would be required.

Mr. Hardy's illustrations of the application of

Makeham's curve to the general population will be of great interest to all statisticians.

The publication of these lectures marks, we hope, a turning-point in actuarial graduation; it means that the study of curve-fitting has now become a part of the curriculum of the actuarial student, and a knowledge of frequency curves must be acquired before the diploma of the Institute is won. This recent development has enormously increased our power of interpreting statistics, and Mr. Hardy will have done actuarial science a great service if this book induces the other members of his profession to follow in his footsteps.

MODERN ORDNANCE.

The Engineering of Ordnance. By Sir A. Trevor Dawson. The Gustave Canet Lecture, delivered at the Twenty-fifth Anniversary Meeting of the Establishment of the Junior Institution of Engineers, at the Hall of the Worshipful Company of Fishmongers, June 30, 1909. Pp. iv+53. (London: Percival Marshall and Co., 1909.) Price 2*s.* 6*d.*

IT is generally understood that progress made in the construction of guns, gun-mountings, explosives, and projectiles during the last half-century far exceeds that made in the preceding five hundred years; but the causes of this great advance, and the methods by which it has been accomplished, are not so well known. In this small book, of little more than fifty pages, the author has summarised the facts in a clear and interesting style, in a fashion perfectly intelligible to ordinary readers. The descriptions of ordnance are assisted by means of a series of excellent illustrations representing ancient weapons as well as the most recent types.

The author is an eminent authority on the subjects of which he treats, and he is a master in the art of exposition. As director in charge of the Ordnance Department of Vickers, Maxim and Co., Sir Trevor Dawson has been able to utilise the valuable training and experience he had previously gained in the Royal Navy, and to play a prominent part in recent advances. The value of the work done by him has just been recognised by a knighthood, and many professional friends will join in congratulating him upon this well-deserved honour. The Junior Institution of Engineers was fortunate in obtaining the services of such a man as their first lecturer and gold medallist under the Canet bequest.

M. Gustave Canet was a most distinguished French ordnance engineer who received his principal training in this country under the late Mr. Joseph Vavasseur, and subsequently did much to advance the design and construction of ordnance in his native country in association with the great firm of Schneider and Co., of Creusot. M. Canet was president of the Institution of Junior Engineers in 1907–8; his death occurred at the close of his term of office, and his family founded a Canet Gold Medal as a memorial in accordance with a wish he had expressed. No fitter tribute to his professional eminence could have been paid than that which the volume under review contains—a tribute from a British ordnance engineer of the first rank to the work which his French collaborateur had done in improving ordnance for both sea and land purposes.

The author has compressed and condensed a considerable mass of material into the modest limits mentioned above, at the same time indicating the great range and variety of the subjects affecting the design of modern ordnance. He has also maintained his sense of proportionate value in dealing with each item. He shows how important have been contributions made by metallurgists, chemists, and mechanical engineers, and how essential has been the work of each. Improvements in steel manufacture lie at the root of advance in gun-construction and the making of projectiles. The chemist has played a great part in these improvements, and has devised much more powerful "propellants" to take the place of gunpowder, as well as high explosives which can be safely fired from guns and be capable of working havoc on an enemy's forces or ships. The mechanical engineer has been no less useful; indeed, it is his lot to utilise all that metallurgists and chemists can do so as to embody their latest discoveries in designs for more powerful and accurate artillery, or in the construction of more efficient gun-mountings. Hydraulic, electric, and pneumatic methods of transmitting and utilising power in connection with ordnance all find a place and use, their relative value and efficiency being differently assessed by different authorities.

Sir Trevor Dawson states the case fairly, and records his own opinions in many instances. For example, what he says in regard to "wire-wound" and "solid-steel" systems of gun-construction is well worth study; and equally so are his remarks on the advantages and disadvantages of hydraulic or electrical power for working and loading heavy guns; or his comparisons of nitro-glycerine and nitro-cellulose powders. All these questions must be studied in the original volume, as limits of space prevent even a summary being given of the author's conclusions. Every reader of the book will gain a clear idea, not merely of the ingenious devices now in ordinary use for loading and working heavy guns or quick-firing guns of moderate size and weight, but of the means by which present practice has been attained. Behind the complete control and apparently easy handling of the largest guns there lies a mass of complicated machinery for the proper maintenance and use of which highly trained staffs are necessary. The "sweet simplicity" which prevailed before steam-power and armour-defence came into use has entirely disappeared, and cannot be restored. One comparison may be mentioned in conclusion. In 1864 the most powerful 12-inch gun was a muzzle loader, twelve calibres in length, weighing about 23·5 tons; its charge of powder weighed 85 lb., the muzzle velocity of the 614 lb. projectile was 1300 feet per second, and it could perforate 16 inches of wrought-iron armour at the muzzle, or 8 inches at the maximum range of 6000 yards. The 12-inch gun of 1909 is a breech-loader, fifty calibres long, weighing nearly 70 tons. Its projectile weighs 850 lb., the muzzle velocity is 3000 feet per second, its perforative power is measured by 52 inches of wrought iron at the muzzle, 37 inches at

6000 yards, and 17·5 inches at 24,000 yards. Readers interested in the subject will find in the book many equally instructive comparisons, illustrating the great strides made during recent years in the engineering of ordnance.

W. H. W.

VEGETABLE PROTEINS.

The Vegetable Proteins. By Dr. Thomas B. Osborne. Pp. xiii+125. With Bibliography. [Monographs on Biochemistry. Edited by Dr. Aders Plimmer and Dr. F. G. Hopkins.] (London: Longmans, Green and Co., 1909.) Price 3*s.* 6*d.* net.

THE extent to which the knowledge of the proteins has increased during the last decade is abundantly witnessed by the fact that this is the fourth in this series of biochemical monographs which is devoted to them. Dr. Osborne is undoubtedly the leading authority on the chemistry of the vegetable proteins, and much of the matter considered in this essay was originally made known by his researches. The vegetable proteins are of importance, not only on their own account, but also because of their analogy to the animal proteins, which are being so closely studied at the present time. For this reason, this monograph will be welcomed by animal physiologists.

The author has chosen to treat the subject broadly, and to give a general discussion of the chemical and physical properties of vegetable proteins rather than to describe the individual proteins. Whilst this method of treatment will commend itself to many, it must not be forgotten that there is nothing fundamental to distinguish vegetable from animal proteins as a whole, and there is a danger of setting up some artificial distinction between the two classes.

A clear distinction is made between the proteins of the plant embryo and the reserve proteins of seeds, which so far have been the materials chiefly examined. The reserve proteins are all very characteristic and yield large proportions of some particular amino-acid when hydrolysed. As Pfeffer has pointed out, they are to be regarded as excretory products, for they can take no further part in metabolism, and are lost to the plant. The reserve proteins are far more stable towards chemical reagents than are the living tissue proteins; this property has enabled them to be more drastically purified than most of the proteins of animal origin.

Perusal of the monograph will very rapidly convince the reader of the great experimental difficulties attending work in this field, partly on account of the great tendency to form colloidal precipitates which are difficult to manipulate, and partly because no absolute methods are at present known which enable one protein to be separated from another.

Although, on the whole, it must be admitted we are only just beginning to gain some insight into the chemical nature of proteins, yet a work of this kind, like the other monographs which have preceded it in the series, is so stimulating, and suggests so many possibilities of research, that it requires no other justification for its issue, and it should be in the hands of every earnest student of biochemistry.

We could have wished the author to have been more exhaustive in his treatment, and to have included, for example, some discussion of Dr. H. T. Brown's recent work. The inter-relationship of the proteins of wheat likewise deserves much fuller discussion.

In conformity with the editors' plan, a bibliography of no fewer than 608 papers, arranged alphabetically according to the authors' names, has been added. The publishers may be congratulated on the improved cover. A further advantage in the style of the series is the possession of the wide margins, which enable the reader to amplify the text by his own notes.

E. F. A.

MORPHOLOGY AND MEDICINE.

Clinical Commentaries deduced from the Morphology of the Human Body. By Prof. Achille De-Giovanni. Translated from the second Italian edition by John Joseph Eyre. Pp. xii+436. (London: Rebman, Limited, 1909.) Price 15*s.* net.

THE object of the author of this work is to lay anew the foundations on which the principles and practice of the physician's art are based. The new foundations are the principles of morphology—morphology as expounded by Haeckel, Gegenbaur, and other great anatomists. Like all enthusiastic reformers, as one may infer from the following passage (p. 206), he has evidently suffered considerably at the hand of his Italian confreres:—

> "The academicians (I call them academicians because, according to their way, they have made known that the epithet of colleague is not suitable)—the academicians will not demean themselves by accepting these stupid things. Then there are those who, posing as reforming geniuses, let fly a smile of compassion, and others who, from the Olympus of the hypercritical criticism of which they seem specialists, qualify these things in the presence of the credulous public as works of magic, because they do not seek to comprehend them."

By way of apology for Prof. De-Giovanni's medical confreres, the reviewer must confess that a full comprehension of these new doctrines is not an easy matter. As in some of the more recent novels of Henry James, one is puzzled to know whether the obscurities are due to a lack of sense on the part of the reader or of the writer. At least, from the following passage in the preface, in which Prof. De-Giovanni explains his purpose—and there are passages equally obscure on every page of the book—it is evident that the translator has found an equal difficulty, and, apparently, has abandoned as hopeless the task of making the meaning of the original clear:—

> "Therefore I think that every clinical investigation should be conducted on the basis of the individuality morphologically verified, for every other verification of the facts and phenomena in relation to doctrine and practice in their turn in every concrete case individualise themselves, or, to speak better, present themselves, not such as they may be according to the data of general biological experience, but such as they must be in the morphological type of the individual under examination."

Instead of speculating on the exact meaning of the passage just cited, it will be more profitable to follow Prof. De-Giovanni into his clinic, attached to the University of Padua—the university where Harvey was taught the anatomy of the heart well-nigh on three centuries ago—and note the manner in which he applies his morphological doctrines to the treatment of disease. He wishes "to establish whether the heart is adequately proportionate to the body or not." He applies the following law, which is given here in italics, as in the original (p. 226):—

> "*If one measures the thickness of the right fist (in left-hand persons of the left), placing the tape-measure on the extremities of the first phalanges of the index and little fingers, which articulate with the respective bones of the metacarpus, and fix the ends of the measure surrounding the joints in such a way that it includes their thickness, one will have the measure of the base of the heart.*"

Prof. De-Giovanni's law has several disadvantages; in the first place, it cannot be applied until the patient is dead, and, in the second, it does not hold true even then. Those who are unaware of Prof. De-Giovanni's researches find, in the manner in which the heart responds to its work, a safe indication of whether it is "adequately proportionate to the body or not."

The scientific value of this book may be judged from the passages which have been cited. It is much to be feared that its doctrines will meet, from English-speaking medical men, the same reception as has been accorded to them by Prof. De-Giovanni's Italian "academicians."

A. K.

ELEMENTARY BOOKS ON BOTANY.

(1) *Pronunciation of Plant Names.* (Reprinted from *The Gardeners' Chronicle.*) Pp. v+94. (London: *The Gardeners' Chronicle*, Ltd., 1909.) Price 1*s.* net.

(2) *Botany.* By Prof. J. Reynolds Green, F.R.S. Pp. 128. (Dent's Scientific Primers.) (London: J. M. Dent and Co., n.d.) Price 1*s.* net.

(3) *Essentials of Botany.* By Joseph Y. Bergen. Pp. ix+380. (Boston, New York, Chicago, and London: Ginn and Co., n.d.) Price 5*s.*

(1) THIS is a distinctly useful little book. Although primarily intended to encourage uniformity of pronunciation on the part of those engaged in horticulture, it will also, in these days of neglect of the classics, repay perusal by the professional botanist. Even the latter is occasionally guilty of a false quantity. To take a single example, one frequently hears Conium pronounced Co′-ni-um, though Co-ni′-um (*cf.* the Greek *κωνειον*) is, of course, more correct. But in some cases the compiler has wisely retained Anglicised pronunciations, even though less strictly correct, in deference to established usage. One is tempted to express the wish that more uniformity could be secured in the pronunciation, not only of plant names, but also of botanical technical terms.

(2) Prof. Green's book will probably prove helpful to school teachers and students who have some previous knowledge of the subject. For such it may tend to broaden their conceptions and offer a new point of view. One of the best features of the book is the rather striking and somewhat novel way in which the general adaptation of the plant-body to its environment is constantly emphasised. For instance, the author points out that the effect of the branching of the plant-body (both shoot and root) is to bring the plant

> "into relationship with as large a portion of the environment as possible. Here is clearly an indication or suggestion of an interchange of material between the two."

But the book is rather seriously marred by a want of accuracy, some carelessness of expression, and a few antiquated views to be found in certain of its portions, particularly those dealing with anatomy, *e.g.* the descriptions of root-structure on pp. 35 *et seq.* In fact, all through the treatment of the physiological is much more satisfactory than that of the anatomical portions. Some of the illustrations, too, leave much to be desired; indeed, in a few cases the figures are badly drawn and inaccurate. Perhaps the worst are Figs. 20, 22, and 30.

(3) Though not without blemishes, "Essentials of Botany" may be characterised as an excellent elementary text-book. It is brightly written, and combines in an attractive manner information with directions for laboratory work. The reading of the book is obviously intended to be accompanied by actual examination of specimens, and throughout the work questions are constantly suggested which the student is left to answer for himself by direct observation. The illustrations are, for the most part, thoroughly good, though in a few cases they are not above criticism. For instance, in Fig. 20 centrosomes are figured (though not named) in a cell from one of the higher plants. Again, the flowers of the willow (Fig. 100) would be improved by the addition of the characteristic nectary.

As many of the plants selected are North American species, the book is naturally more suitable for use in American than in English schools. It may, however, be heartily recommended for use also on this side of the Atlantic, though it is to be regretted that the author did not supplement the use of American plant names by the addition of the Latin names as footnotes. This is only done in some cases (*e.g.* p. 183, &c.).

We thoroughly endorse Dr. Bergen's opinion that ecology (except in the most elementary form), and also the detailed discussion of evolution, are better omitted from the average school curriculum.

OUR BOOK SHELF.

Geology in the Field. The Jubilee Volume of the Geologists' Association (1858–1908). Edited by H. W. Monckton and R. S. Herries. Part i. Pp. iv+209. (London: Edward Stanford, 1909.) Price 5*s.* net.

IN commemoration of their jubilee, which took place on December 17, 1908, the council of the Geologists' Association decided to bring out a volume dealing with the geology of those parts of England and Wales which have been visited by the Association during the course of its excursions. The volume, which promises to attain a much larger size than was expected, is to be issued in four parts, the first of which is now before us. It is a well-printed work of 209 pages, with four plates and thirty-four text-illustrations; and it deals with the district north of the Thames from Oxfordshire to Bedfordshire and the eastern counties. It comprises seven articles, with the following titles: (1) Middlesex and Hertfordshire, by Mr. J. Hopkinson; (2) Essex, by Mr. T. V. Holmes; (3) The Pliocene Deposits of the Eastern Counties, by Mr. F. W. Harmer; (4) The Pleistocene Period in the Eastern Counties, by Mr. Harmer; (5) Cambridgeshire, Bedfordshire, and West Norfolk, by Mr. R. H. Rastall; (6) Buckinghamshire, by Dr. A. Morley Davies; and (7) The Oxford and Banbury District, by Mr. J. A. Douglas.

In the articles relating to the several counties we have admirable summaries of what is known of the local geology, with discussions on some controverted questions, and a good deal of new and original matter, special attention being given in most cases to the localities visited during excursions of the association. Accounts brought up to date are given of the classic sections, such as those near Watford and Bushey, at Ilford, Upminster, and Grays, at Shotover Hill, Aylesbury, and Upware. The Palæolithic gravels of Rickmansworth, and the derived sarsen stones lately found there, are illustrated in photographic plates; the Hertfordshire Bourne and the Colne swallow-holes near South Mimms; the Dene-holes of Essex; the physiography of the Cambridge area; the relations of the Jurassic and Cretaceous formations, and of the Shotover Sands and Lower Greensand, are among the many topics discussed, apart from the more particular descriptions of the strata and their fossils. The vagaries of modern palæontological nomenclature are noticeable in different articles, as in the case of *Ammonites varians* (p. 4) and *Schloenbachia varians* (p. 168), to say nothing of some other names, the changes in which form the most serious stumbling-block to the student.

The subject of glaciation is dealt with in several of the articles, and more fully in that by Mr. Harmer on the East Anglian Boulder-clays. His essay, illustrated by two maps showing the distribution of the Drifts and the direction of movement of the ice-sheets, is in itself an important contribution to the advancement of science.

The work will thus be of great practical value to the field-student, and it must be consulted by everyone interested in the progress of geology in this country. At the same time, for historical purposes, the original records of excursions published in the Proceedings of the association must not be neglected.

Who's Who, 1910. Pp. xxiv+2162. (London: A. and C. Black.) Price 10*s*. net.
Who's Who Year Book for 1910. Pp. vii+162. (London: A. and C. Black.) Price 1*s*. net.
The Writers' and Artists' Year Book, 1910. Pp. viii+127. (London: A. and C. Black.) Price 1*s*. net.
The Englishwoman's Year Book and Directory, 1910. Edited by G. E. Mitton. Pp. xxvi+382. (London: A. and C. Black.) Price 2*s*. 6*d*. net.
Hazell's Annual for 1910. Edited by Hammond Hall. Pp. lxiii+608. (London: Hazell, Watson and Viney, Ltd.) Price 3*s*. 6*d*. net.

IT would be difficult to select for the busy man a more useful set of works of reference than the new issues of the five annual publications under notice. Each one of them is so well known that it is sufficient in every case to say that, not only has there been no diminution of accuracy and interest, but the various editors have all succeeded in adding to the completeness of the books entrusted to their care.

The long obituary at the beginning of the book, and the addition of some fifty pages to "Who's Who," serve to indicate that there have been material changes made in the new issue. "Who's Who Year Book" continues to be an indispensable supplement to the larger work, to which, indeed, it is a really useful key.

Writers, artists, and photographers will find in the third periodical information which it is difficult to obtain elsewhere.

The volume specially intended for women has been revised very thoroughly. Full information is provided concerning the part now taken by women in professional and other work, and the book may be recommended especially to schoolmistresses and parents desirous of finding suitable avocations for girls leaving secondary and other schools.

Among the new features of "Hazell's Annual" may be mentioned the introduction of signed articles. For example, Sir Oliver Lodge, F.R.S., contributes an article on the new physics, Sir Hiram Maxim writes on the evolution of the flying machine, and Mr. C. C. Turner on aërial navigation in 1909.

The New Physics: Sound. By Joseph Battell. Pp. xvi+274+xlvii. (Middlebury, Vt., U.S.A.: The American Publishing Co.; London: A. F. Bird, 1909.) Price 6*s*. 6*d*. net.

VERY few pages of this new treatment of physics need be read before we reach the conclusion that "the old is better." Mr. Battell's object in writing this book is to give "a condensed but complete exposure of the errors in the present theory of sound." He has been "for years opposed to all undulatory theories, as at variance with the fundamental principles of creation, and otherwise not only entirely, but very foolishly, erroneous," and while anxious to give every credit to such men as Koenig and Helmholtz, he comes to the rescue of truth with a book to prove that "sound, like light and odour, is composed of infinitesimal particles of matter." It is really extraordinary how such an effort as this can secure a publisher. No matter where a reader begins, whether at the beginning, the middle, or the end, the result is the same; it is impossible to interpret the author's meaning. Here and there, it is true, there are a few intelligible sentences, but in the main they are obscure and apparently unconnected with what precedes and follows. As an example of this we may quote the following, and leave it to the reader to gather what information he can.

"That light is made by bodies made to make it, as the sun or a lamp; or odour by things made to make it, as a sweet pea or water lily,—that is, by things having light-making or odour-making machinery, and that they can make no other light or odours than those they were made to make, or have the machinery to make,—is no more true, than that nothing can make Sound unless made to make it, or any sound except what it was made to make, and that means any unless it has the machinery to make it."

The author is, without doubt, ingenious in his way of making his particles submit to his theory. Perhaps this results from his acquaintance with horse-rearing. (It should be mentioned that among Mr. Battell's other publications are several volumes of the "American Stallion Register.") For instance, in order to account for the fact that sound is not propagated in a vacuum—at first sight a difficult thing to do on a corpuscular theory—the author naïvely suggests that the reason is the same as that which makes birds unable to fly without air.

Those who have read Mr. Battell's previous scientific work, "Ellen, or Whisperings of an Old Pine," will find this volume equally amusing, and from that point of view the book is, perhaps, worth its price; but those buying it in the expectation of a reasoned text-book for the study of physics will be disappointed.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Function of Reissner's Fibre and the Ependymal Groove.

THANKS mainly to the investigations of Porter E. Sargent, Reissner's fibre is now known to occur throughout the vertebrate series from the lamprey upwards. Not long ago Mr. G. E. Nicholls directed attention in these columns to its occurrence in the frog, and Sir Victor Horsley (*Brain*, vol. xxxi., 1908) has recently shown that it occurs in monkeys (Macacus). I have myself already described it in Geotria, and have lately observed it in the tuatara and in the cat. Its position and relations are remarkably constant. Commencing beneath the posterior commissure, it extends backwards to the hinder extremity of the spinal cord, lying, at any rate for the greater part of its length, quite free in the iter, the fourth ventricle, and the canalis centralis. Anteriorly it breaks up into very slender fibrils, which are attached to the columnar epithelium of the ependymal groove.

The ependymal groove, though its existence has been strangely ignored by most observers, also occurs throughout the vertebrate series from cyclostomes to mammals. It is found typically as a deep longitudinal furrow on the ventral aspect of the posterior commissure, lined by high columnar epithelium, very different in appearance from that which lines the greater part of the brain-cavity. In this highly specialised condition I have observed it in the lamprey, the tuatara, and the cat. I suggested some years ago, in the case of the lamprey, before the connection of this structure with Reissner's fibre was known, that it might aid in the circulation of the cerebro-spinal fluid, by means of cilia which I thought I had detected on the epithelial cells. Whether this be so or not, I now think that the ependymal groove may have another, and perhaps more important function as an intra-cerebral sense-organ.

Sargent, as is well known, has interpreted Reissner's fibre as a nervous structure which serves for the "short-circuiting" of motor (optic) reflexes, and he regards the epithelium of the ependymal groove merely as an attachment plate for the fibre. This seems to me hardly a sufficient explanation of the existence of such a highly differentiated organ.

The nervous nature of Reissner's fibre is very far from having been demonstrated, and though I was formerly led to agree with Sargent's opinion on this subject, I can do so no longer. Sir Victor Horsley and Dr. McNalty (*loc. cit.*) have shown that electrolytic lesions do not cause any degenerative changes in Reissner's fibre such as would be expected if it were a nerve-bundle, and this result is, of course, totally opposed to that of Sargent's earlier experiments, by which he endeavoured to establish the truth of the optic reflex theory. On the other hand, there is a certain amount of evidence to show that Reissner's fibre is highly elastic, and therefore more of the nature of connective tissue. Thus it is often found that when the spinal cord has been cut across, the fibre has "sprung" and twisted itself into a knot or gnarl in some part of the brain-cavity. This seems to indicate that the fibre in life is under considerable tension. My colleague, Mr. Nicholls, who has for some time past been working at Reissner's fibre in this laboratory, will, I hope, bring forward some further evidence on this head very shortly.

I now wish to suggest, for the consideration of physiologists, that Reissner's fibre and the epithelium of the ependymal groove may form part of an apparatus for regulating flexure of the body. Any such flexure would, it appears to me, tend to alter the tension of Reissner's fibre, and thereby exert a mechanical stimulus upon the cells of the ependymal groove to which it is attached. We may suppose that the stimulus received by these sensory cells is transmitted to appropriate nerve-cells in the brain, and that the deviations of the long axis of the body from the normal position may possibly be regulated by reflex action. We may compare the function of the semicircular canals of vertebrates; also that of the "statocysts" of many invertebrates, which serve, by means of mechanical stimuli due to the action of gravity, automatically to regulate the orientation of the body.

The position of Reissner's fibre, entirely enclosed within the brain and spinal cord, renders it extremely difficult to perform any experiments to test the truth of this hypothesis, but I hope that the ingenuity of experimental physiologists may overcome even such a formidable obstacle as this.

ARTHUR DENDY.
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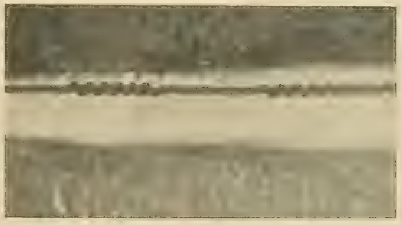
Strand, W.C.

WITH reference to Prof. Dendy's remarks on Reissner's fibre and the suggestion that he puts forward as to its function, I may perhaps be permitted to add a few words.

Of the preformed nature and of the universal occurrence of the fibre throughout the vertebrate series there can remain, I think, no possible doubt.

During the past two years in which I have been engaged in investigating this structure I have examined sections of the brains of a large number of specimens of more than five-and-twenty different genera taken at random from all the great classes of vertebrates, and in *no case* have I failed to find the fibre in properly fixed material. Any of the commonly employed fixing reagents may be used, but it is essential that the material shall be fixed immediately after death.

I have been greatly impressed with the extraordinary elasticity of the fibre, which in life appears normally to be under considerable tension, so that if it be severed in the fresh state the free ends recoil sharply. In one case, where in removing the brain of a toad the fibre was accidentally snapped, so considerable was this recoil that, as subsequent examination of the sections revealed, the free end of the fibre sprang forward into the cavity of the fore-brain, the thin roof of which it actually perforated. Another striking instance of this same character is furnished in certain sections of the terminal portion of the spinal cord of the lamprey, a photomicrograph of which, kindly taken for me by Mr. R. W. H. Row, is here reproduced.



Photomicrograph of a section of the terminal portion of the spinal cord of the lamprey. ×600.

In this case the cord was severed when fixation was only partially effected, and a sudden recoil having been prevented by the partial fixation, the fibre was withdrawn backwards towards its attached end by a more gradual retraction that resulted in the production of a number (twenty-nine) of close coils, two of which appear in the photograph.

From these and other facts I am persuaded that the structure is *not* a nerve, but rather an elastic rod with a merely mechanical function, and to my mind the suggestion Prof. Dendy puts forward as to its function is quite a reasonably probable one.

Geo. E. Nicholls.

King's College, December 17.

Nitrogen-fixing Bacteria and Non-Leguminous Plants.

I regret that owing to Mr. A. D. Hall's letter of July 12 (Nature, July 22) appearing during vacation, I had not an opportunity of seeing it until my return to college at the commencement of term. I trust that, in spite of the long delay, I may yet be allowed to reply to some of Mr. Hall's questions.

Mr. Hall commences by stating that my conclusions are based "on experiments to show that Pseudomonas, the bacterium associated with the leguminous plants, will fix more nitrogen, &c." This is not correct, for it is definitely stated in the abstract that both the Pseudomonas and the Azotobacter used for the nitrogen determination results quoted were obtained from a non-leguminous plant—the root tubercles of Cycas.

There are four non-leguminous plants possessing root tubercles which contain nitrogen-fixing organisms. In all four a species or variety of Pseudomonas is present, but in Cycas only is Pseudomonas found living outside the cortical cells, in the algal zone, and in Cycas only is Pseudomonas found in association with Azotobacter. As stated in my paper, the nitrogen determinations quoted had reference only to these organisms from Cycas, and were made in order to determine to what extent, if any, Cycas *Azotobacter* assisted Cycas *Pseudomonas* in assimilating free nitrogen.

"Pseudomonas, the bacterium associated with the leguminous plants," and the use of "a reasonably active culture" of Azotobacter, to quote Mr. Hall, had nothing to do with the determination experiments. On what grounds, then, does Mr. Hall state that "the only conclusion that could be drawn from Prof. Bottomley's figures would be that Pseudomonas injuriously affects the power of Azotobacter to fix nitrogen"? Naturally, a determination of the amount of nitrogen fixed by the Azotobacter alone was made (for Mr. Hall's information I may say that it was very small, —0·56 mgr.), but as the immediate object of the experiment was to determine the effect of Cycas *Azotobacter* on Cycas *Pseudomonas*, it was not thought necessary to quote the figures for Cycas *Azotobacter* alone, especially as this will be dealt with in a future paper.

Again, when speaking of the experiments with oats, Mr. Hall says that the mean error of ±10 per cent. found in Rothamsted experiments "would more than cover the differences observed by Prof. Bottomley's experiment with oats." The figures given for oats are:—average weight per plant, untreated, 0·42 grm.; treated, 0·74 grm.; increase, 0·32 grm., or 76 per cent. Surely Mr. Hall cannot have read the abstract carefully or he would not have stated that a mean error of ±10 per cent. more than covers an increase of 76 per cent.! As regards probable experimental error, the abstract states that the oats were "grown in sand, dressed with phosphates, potash and lime." Why, then, should Mr. Hall assume that they were grown "in soil which presumably already contains both organisms"?

As regards the field experiment with barley, duplicate samples were not taken from different parts of the untreated plot, but the total yields from treated and untreated plots were kept separate, and the treated showed an increase of 13·6 per cent. The sample for estimation of nitrogen content was taken from the bulk in each case.

The treated bulbs gave an increased yield of 18·6 per cent. They were not selected as being specially "suitable for experiments on nutrition," but to determine the effect of the mixed culture of bacteria on a totally different kind of plant from any of the other experiments. The bulbs were already planted when the experiment commenced, hence the original weight of the bulbs is not available. As, however, the bed contained 500 bulbs, and was divided into two equal halves with 250 bulbs in each, one may assume that the original weight in each half was approximately equal.

As regards the culture solution "being a considerable factor in any beneficial effect experienced," it is difficult to comprehend how 4½ grs. potassium phosphate and ½ gr. magnesium sulphate dissolved in a gallon of water for the culture solution, and this afterwards diluted with fifty gallons of water before applying, could possibly produce any appreciable effect on growing crops. Assuming that the bacteria had not used up any of the culture salts in their growth to produce the culture solution, can one imagine any benefit to plants by watering them with a solution containing 1/50,000 part of potassium phosphate and 1/450,000 part magnesium sulphate?

Mr. Hall appears to consider his questions "somewhat critical." True and fair criticism is always welcome in scientific investigation, for it is only thus that one can get at the truth of things, but misstatements of fact or misrepresentations of results exceed the bounds of criticism. So far as Mr. Hall correctly states the experiments and results given, one welcomes his criticisms.

W. B. Bottomley.

King's College, Strand, W.C.,
November 25.

In Prof. Bottomley's paper in the Proceedings of the Royal Society I cannot read that he makes any claim that the Pseudomonas and the Azotobacter he isolated from Cycas were in any way different in kind from the usual forms of these organisms. When I used the expression "Pseudomonas, the bacterium associated with leguminous plants," it was as a sort of explanatory label for the lay reader, but if it has confused the issue at all I would still repeat my former criticism on Prof. Bottomley's basis that the Pseudomonas and Azotobacter he used are special and unlike all others. The question was if "the association gave an increased power of assimilating free nitrogen," and Prof. Bottomley's figures are:—

Control...	0·48 mgm. nitrogen
Pseudomonas alone	0·91 ,, ,,
Pseudomonas + Azotobacter ...	1·24 ,, ,,

and I asked if the action of Azotobacter alone ought not also to be known before any answer is possible. Prof. Bottomley now tells us that Azotobacter alone fixes 0·56 mgm., so that I still conclude that Pseudomonas and Azotobacter together (1·24) are less effective than when grown separately (0·91+0·56), were I not more inclined to think that all the differences are within the limits of experimental error.

To pass to the experiments with plants, by an error which the context rendered sufficiently obvious I wrote "oats" instead of barley when dealing with Prof. Bottomley's first-quoted experiment with soil. The oat experiment is beside the point; it only demonstrates fixation of nitrogen by Azotobacter and Pseudomonas—a fact on which we are all agreed; but when Prof. Bottomley claims increased crop production due to inoculation with the two organisms in the open ground, we do want the means of judging what weight to attach to the results. He gives for the first barley experiment a gain of 13·6 per cent.; in barley 2 the increase cannot be estimated; the Galtonia experiment shows 18·6 per cent. increase, the parsnips 21·7 per cent. Such percentage differences are not outside the limits of error for a single plot experiment worked on a large scale with every condition in favour of accuracy; when they are differences between lots of 250 bulbs or 68 parsnips I have no hesitation in regarding them as without any significance whatever. I have just had pulled and weighed two lots of fifty successive roots of mangolds growing side by side in neighbouring rows on the same plot, inside rows perfectly similar to the eye and on a very uniform plot, yet one lot weighed 220 lb., the other lot 176 lb., a difference of 25 per cent. The assistant who gathered the roots was quite unaware of the question involved; his instructions were to begin inside the plot and take fifty consecutive roots along a row, then another fifty roots alongside; the difference in the weights merely represents the error of random sampling when numbers are small.

Prof. Bottomley is very scornful over my suggestion that the nutrient salts in the bacterial culture may have brought about an increase in yield, but if it is easy to represent their quantity as small to the verge of ridicule, exactly the same argument might be turned against the bacteria he added. No factor should be neglected to equalise the conditions of the controls and the treated plots. I can give Prof. Bottomley examples in which the nutrient salts accompanying a bacterial inoculation have not been negligible in their effects.

I put my questions to Prof. Bottomley because he does not seem to recognise how large an experimental error he must expect; the conclusions he reaches are of such importance as to demand a more serious body of evidence than the specially selected cases he has put before us.

A. D. Hall.

The Rothamsted Experimental Station, December 13.

Positions of Birds' Nests in Hedges.

What has puzzled Lieut.-Colonel Walsh (Nature, December 16) may be referred to the law of protective devices on the part of birds, and I may say that his facts have been long familiar to other field naturalists and myself. I do not think that the direction north-south or east-west has anything to do with the selection of the nest site. If, at this season of the year, hedges are examined, even very careful "bird boys" and men will be astonished at a much larger number of nests than they observed in summer. If an explored hedge skirts on one side a public road, an "occupation" road, or right-of-way paths, it will be generally found that the nests are on the field side of the hedge, and, therefore, when looked for from the other side, much more difficult to discover than if they were placed on the road or pathway side. In cases where the hedge divides a field from a plantation, the nests are invariably on the plantation side. I knew that very well when I was a boy "nester," and was struck with it only a few days ago on examining a long stretch of hedge-fencing from a semi-public road near my home. However, there may be some esoteric law of bird-life in what Lieut.-Colonel Walsh says. Certainly his facts are most interesting.

G. W. Murdoch.

Woodbine House, Bentham, Yorkshire,
December 17.

RADIUM AND CANCER.

The *Revue générale des Sciences* of November 30 contains a lengthy and important article by Dr. Louis Wickham on the therapeutic action of radium on cancer, based upon observations made on 1200 patients suffering from tumours, half of which are stated to have been malignant. Dr. Wickham himself has demonstrated recently in London and in Belfast the nature of the results he has obtained, and full reports are available in the Proceedings of the Royal Society of Medicine and in the *British Medical Journal.* Therefore there is no need to reproduce the details of the article. The illustrations in the *Revue générale des Sciences* are even more startling than those which have appeared in the English journals cited. The appearances presented before and after treatment are such as will, almost surely, carry conviction to all laymen, whether healthy or suffering from cancer, that radium can cure the disease. But Dr. Wickham does not write in a corresponding spirit of optimism. Indeed, the only note of triumph is the phrase "It is delightful to think that the whole evolution of radiotherapy (the marvellous discovery of radium by P. Curie and Mme. Curie, the construction of perfected apparatus, therapeutical applications) is almost entirely French." No one may grudge this full measure of recognition to the advances made possible in Paris, on the biological action of radium, by collaboration between laboratories of physics, chemistry, and pathology. Not the least measure of praise is due to Dr. Wickham himself, both for his initiative and for his achievements.

Persons who possess an intimate knowledge of the clinical course and pathology of cancer will be less impressed by the pictures of cured cases than by what Dr. Wickham writes and what he omits to refer to. The evidence of diagnosis and of microscopical structure is imperfect. The duration of the period of benefit after treatment, as well as the ultimate fate of the patients, are the criteria by which the success of surgery is measured; but the evidence advanced in Paris falls short of good standards in both respects. Dr. Wickham lays no claim to successful treatment of secondary deposits; he says severe cases ought only to be treated when the surgeon can do nothing, and that it is too early yet to say if radium is the means which ought always to be employed. A warning is given of the necessity for caution in appraising the value of any new treatment, and, above all, of the necessity of avoiding the risk of depriving patients of other treatment which has proved itself superior, especially of surgery.

The results obtained in Paris have attracted the attention of the world. The hopes they have aroused have awakened yet greater expectations for the future, when larger quantities of radium shall be available, and the technique better mastered. Meantime, notwithstanding Dr. Wickham's caution, the writer considers a further note of warning is necessary. All that is claimed for radium is a beneficial action when applied directly to primary growths. Secondary growths inaccessible to direct surgical removal are inaccessible to radium in consequence of the restricted penetration of the rays. Whether or not means will be devised for attacking deep secondary deposits—the very site of which it may be impossible to determine—remains to be seen. The actual injection of emanation solution has met with no success. Nor is the evidence that radium has a marked elective action for cancer tissue so strong, at present, as to arouse any great hopes from more efficacious means of flooding the body with radio-activity. In short, radium does not appear to be nature's remedy for cancer, but an empirical remedy with the same shortcomings as all other such in the case of cancer, in that the local condition alone is attacked and the constitutional conditions are unassailable.

That the body can generate powers of its own, leading to constitutional changes which enable it to deal effectively with cancer, has been abundantly demonstrated by recent experiment. In given circumstances, 100 per cent. of animals bearing transplanted tumours can cure themselves. The facts ascertained show that the natural forces of the body can cope both with secondary deposits and with primary growths. Though this process of natural cure is not, and may not speedily, be elucidated, still, it is not too sanguine an expectation to anticipate that ultimately it will be. The means for checking the ravages of cancer will be found, not by searching the surface of the earth for a vegetable remedy, nor the bowels of the earth for a mineral one, but by following the definite clue, that in the living body itself forces can be elicited which effectively combat the disease. Until that goal shall be attained, when surgery fails or is unavailable, relief may be sought, but cannot be guaranteed, by resorting to treatment with radium, the full possibilities of which are not yet developed, even in Paris.

E. F. B.

THE GREAT WALL OF CHINA.[1]

IT is two thousand years since Chi-Hwangti established his fame by building the Great Wall. Dr. Geil, in the preface to his book, suggests that after so long an interval we remain ignorant of the features of this greatest of all mural ramparts. "There is a Great Wall of China; so much the geographers tell everybody, but they do not make it clear whether it is built of China; or why it is, or how long it is, or how long it has been." We must remind the author that accurate details concerning the wall have been available for at least two centuries. The Jesuit missionaries under the auspices of the Emperor Kang-hi surveyed the wall from the eastern seaboard to the desert of Turkestan. Its course was set down on their map, published in 1718, the first authentic map of the Empire. This was accompanied by a narrative of their survey, giving an account of the wall, its measurements, its length, and the material used in building. Later geographers followed.

The work done, however, by previous travellers need not detract from the merit of the journey made by Dr. Geil. His route lay over one thousand miles in a very rough country, and among people who are not given to welcoming the stranger at their gate, yet the author seems to have covered the ground rapidly, and to have enjoyed immunity from the delays, discomforts, and accidents that impede the progress of the explorer in eastern Asia. He must be congratulated also on securing an admirable series of photographs to illustrate his volume. Taken alone, they supply a valuable pictorial representation of this wonderful barrier, affording evidence of the skill of the builders who at that early period and with the most primitive appliances overcame engineering difficulties that would prove formidable in our own day with all the facilities afforded by science.

Dr. Stein has recently discovered that the wall extends much further west than was previously known, along a desert track in Turkestan, hitherto unexplored. He also found documentary evidence to show that part of this western extension was erected two centuries B.C., during the reign of Chi-Hwangti.

Dr. Geil gives an account of the life and work of Chi-Hwangti at some length, whom he calls "Chin."[2] He was a reformer who built the Great Wall to shut out the Huns, extended and consolidated the Empire, made highways to facilitate intercommunication, and was a promoter of agriculture and industry. He was a prince of hustlers, with an eye to national development and the filling of his treasury. He was a man of boundless ambition and fantastic wickedness. In order that he might pose, and be handed down to posterity, as first Emperor of China, he burnt the classic writings and ancient chronicles of the Empire, and put to death more than four hundred followers of Confucius, an act which earned for him the lasting hatred of the literati. The building of the wall, his greatest work, was accomplished by forced labour, and the builders, under pain of death, had either to give their unremitting toil or be built into the wall as part of the material for their country's defence. "Chin" was an economist.

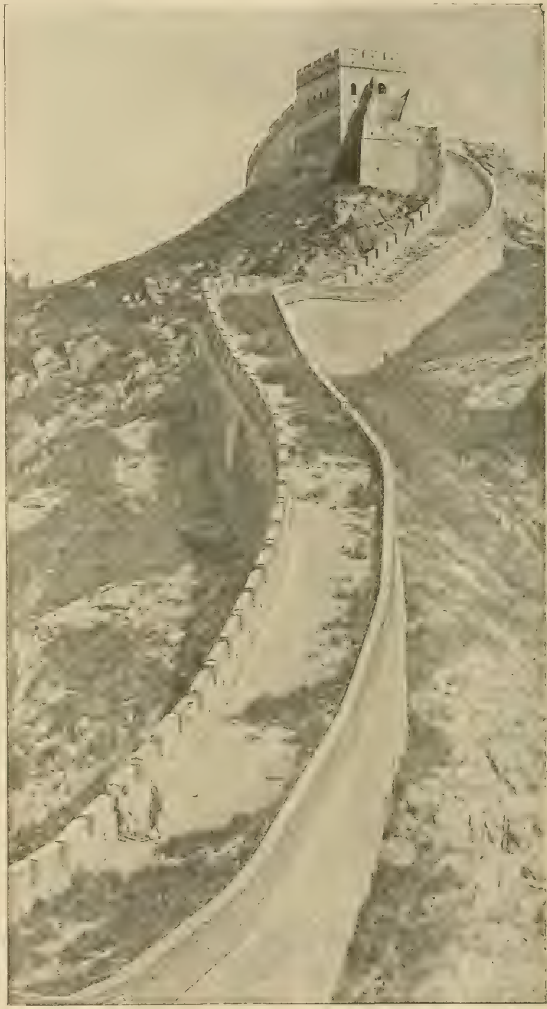


Photo. by H. G. Ponting.

FIG. 1.—The Great Wall ascending a Steep Declivity near the Nankow Pass. From "The Great Wall of China."

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[1] "The Great Wall of China." By Dr. William Edgar Geil. Pp. xviii+351. (London: John Murray, 1909.) Price 21s. net.

[2] Chi-Hwangti, Second Emperor of the Tsin dynasty.

The author admires this potentate's pushfulness, and would welcome the advent of such another ruler, or a reincarnation of Chin, to awaken China from her sleep of ages—that is, Chin modernised and shorn of his wickedness. He may not have long to wait. Dr. Geil's historical notes on the life and doings of this famous emperor are written with force and an entertaining display of humour. But, after all, the manner of building, it is a sordid tale of suffering, of which the wall is a lasting memorial.

Dr. Geil pauses at intervals in his journey to copy ancient tablets of local wall interest, and to consider, at length, the myths and superstitions of the Chinese, and the condition of the world coeval with Chin the hero. The rise and progress of Genghis Khan, "the red raider," who eventually pierced the barrier and conquered China, are dealt with. He is described as "A man of elemental fury beyond the sweep of twentieth century imagination," whose bloody career did not end until he had slain as many people as now live in all New England, New York, and Pennsylvania—a monster of cruelty. Yet his grandson, Kublai Khan, who came to the throne, proved one of the most enlightened monarchs known to Chinese history. He excavated the Grand Canal, and extended his sway as far as Moscow and the Levant. Dr. Geil gives a brief *résumé* of mediæval China since the building of the wall to the present dynasty—the Manchu. He eulogises the good work done by the Christian missions, and hails the light of a reformation that in the future will make China a world Power of the first rank.

To anyone who knows the intellectual, as well as practical, potentialities of the Chinese, the eventual rise of this Yellow Peril seems far from impossible. Besides the missions of peace that are at work, there are other and rival missions from the armed camps of Europe and Japan urging forward the Chinese, aiding them in rearing a great wall of militarism more formidable than the barrier built by Chi-Hwangti to bar all foreign interference with the internal affairs of "The Central Flowery Land."

In conclusion, this modern view of the Great Wall, with its wealth of illustrations, and the author's discussions over a wide field, should afford instruction and entertainment to the general reader. As a book of travels, further details regarding the route traversed would have been welcome.

J. T.

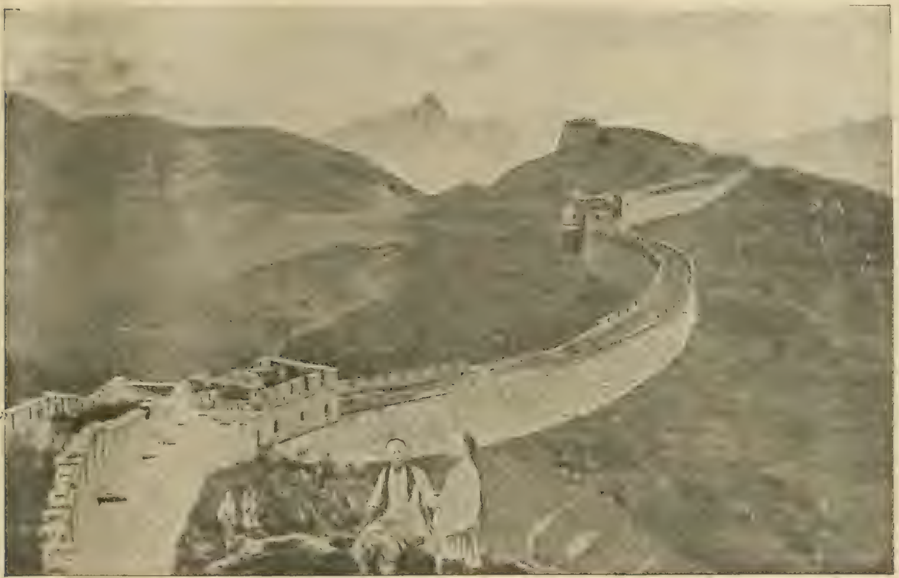

FIG. 2.—Lienhwachih. From "The Great Wall of China."

DR. LUDWIG MOND, F.R.S.

BY the death of Dr. Ludwig Mond this country has lost one of the most eminent of her chemical technologists, and the world is the poorer by the passing away of one who, himself a man of science of no mean attainments, gave liberally of the wealth which his knowledge and skill as a technologist brought him in order to promote the dignity and usefulness of science. Dr. Mond, as he would have been the first to admit, undoubtedly owed much to England, and he gave practical recognition of the extent of his indebtedness by the open-handed generosity with which during his life-time he supported and endowed her scientific institutions. He never forgot that it was through science he had prospered, and he was ever ready to return to the service of science a large measure of the riches she had conferred upon him.

The International Catalogue of Scientific Literature, and the establishment and endowment of the Davy-Faraday Laboratory, are splendid monuments more enduring that brass. With these Dr. Mond's name will for ever be associated. But in reality they constitute only a fraction of the benefits he conferred upon science, for there was hardly a single movement connected with the advancement or spread of physical science which did not find in him a generous and, at times, an enthusiastic and inspiriting supporter. In one other respect, too, his substance was always at the service of science. No appeal from those who enjoyed his confidence, or in whose judgment he had learned to trust, on behalf of the weak brother who had fallen by the wayside, was ever made in vain; and numberless acts of kindness, of sympathy, and of substantial help of which the world knows little or nothing, and of which even the recipients in many cases never knew the source, are recorded to his credit.

But it was not only by his wealth that Dr. Mond served science. In the organisation of science and in her councils he gave of his mental and intellectual powers with the same unstinted liberality that he gave of his material possessions. His knowledge and experience, his remarkable business aptitudes, his skill in the management of men, his faculty for organisation and direction, were freely at the service of every scientific society that had the good fortune to enlist his sympathy, or the wisdom to invite his cooperation.

Ludwig Mond was born in Cassel in 1839, and, after having passed through the Polytechnic of his native place, he went to Marburg to study chemistry under Kolbe. Thence he repaired to Heidelberg to work under Bunsen, and to enjoy his full share of that alternation of study and play—each as strenuous as the other—which characterises the university life of that famous seat of learning. At Heidelberg he took his degree, and, attaching himself to technology, obtained situations in chemical works in Germany. At about this time he was attracted by a problem which had long baffled practical chemists, namely, the recovery of the sulphur employed incidentally in the Leblanc process in the conversion of common salt into soda, and which had passed from the oil of vitriol into the bye-product known as alkali-waste. He devised and patented a process for treating alkali waste, which, although long since superseded by others more economical in working, had a considerably measure of success for a time. He came to England with a view to the introduction of his method into the great alkali works of South Lancashire, Tyneside, and the Clyde district, and it was adopted by a number of manufacturers, notably in Widnes, in Newcastle, and by the Tennants of Glasgow. After a short stay in Holland, where he erected, and for a time managed, a factory to work the Leblanc process, he returned to this country and entered the chemical works of Hutchinson and Earle at Widnes.

Dr. Mond was then twenty-eight years of age. In the previous year he had married his cousin, Miss Frida Loewenthal, and he settled down in the most dismal of all the manufacturing towns in Lancashire with the intention of devoting his talents and energy to the business of manufacturing alkali and the other products commonly associated with it. At this period soda was exclusively made in this country by the Leblanc process, which involves the use of sulphuric acid and the production of large quantities of hydrochloric acid, as well as the formation of the alkali waste already referred to. Other processes had been suggested, and some had actually been brought into successful operation, as, for example, the cryolite process invented by Julius Thomsen, of Copenhagen, and worked so far back as 1857. It was known that common salt might be changed to some extent into bicarbonate of soda by the action of carbonic acid in presence of ammonia. Dyar and Hemming had worked out a method based on this principle, but their efforts to compete with the Leblanc soda resulted in failure, and the firm was ruined. In theory the process was seductively simple, but all attempts to determine the practical conditions needed to ensure complete conversion were unavailing until the method was systematically investigated by two young Belgian chemical engineers, the brothers Solvay, who, in the early 'seventies, devised the modification of the Dyar and Hemming process which has since been known as the ammonia-soda or Solvay process.

Dr. Mond was afforded an opportunity of judging the practicability of the process as thus improved, and so sanguine was he of its commercial possibilities that he determined to embark his little capital in acquiring a licence to work the ammonia-soda process in England. He enlisted the sympathy of his friend Mr. J. T. Brunner (now the Right Hon. Sir John Brunner, Bart., M.P.) with the enterprise, and the result was the formation of the firm of Brunner, Mond and Co., who acquired the Winnington Hall estate, near Northwich, and erected their works over the Cheshire salt deposits. The success of this firm has been phenomenal, and to-day the Winnington works is one of the largest, if not actually the largest, manufactory of the kind in the world. Much of this success was due, in the outset, to the genius and inventive skill of Dr. Mond. In the beginning innumerable difficulties were met with. During the first twelve months, as Sir John Brunner recently said, everything that could explode exploded, and everything that would break broke, until the partners had little left but their credit and their licence from Ernest Solvay. Thanks in large measure to the energy and resourcefulness of Dr. Mond, these troubles were circumvented, and in a surprisingly short space of time the process became a magnificent success. Leblanc soda would have become a thing of the past had it not been for its bye-product, the hydrochloric acid, which alone saved it from extinction.

If the Leblanc process wasted its sulphur, the ammonia-soda process equally wasted its chlorine, and Dr. Mond made repeated attempts to remove this blot on the theoretical cycle of operations upon which the method is based. At one time it seemed as if success had attended his efforts, but the result showed that the economical production of bleaching powder from calcium chloride under existing conditions is a problem which still remains to be solved. Whether the ammonia-soda process has within it the basis of permanent success, time alone can show. As regards the production of ammonia and the means taken for its recovery and preservation, it is difficult to see where fresh economies are possible. In the meantime, new, or at least improved, sources of energy are rapidly becoming available, and every decade shows progress in the methods of transforming this energy into work. Dr. Mond himself devised plans for greatly augmenting its supply, and in the Mond gas there is a relatively cheap source of power which, while it may contribute incidentally to the supply of the all-essential ammonia, may indirectly undermine the stability of the very process with which his name is primarily and more particularly associated. The economical production of alkali from common salt by electrolytic methods in this country is largely a question of the transformation of the potential energy in coal into electrical power, and although theoretically a definite quantity of ammonia is capable of turning an indefinitely large quantity of salt into soda, this can only be effected by the expenditure of energy which itself costs money to produce and apply.

Dr. Mond had a remarkable aptitude for pushing his experimental inquiries into abstract fields of research, and for promptly turning the results to practical account. His discovery, in collaboration with

Langer and Quincke, of an entirely new and altogether unlooked-for group of chemical compounds, now known as the metallic carbonyls, is an admirable illustration of this faculty. The formation of nickel carbonyl—a most interesting substance produced by the direct combination of carbon monoxide with nickel —led to the establishment by him of a new process for the extraction of the metal from its ores which is now in successful operation by the Mond Nickel Company at Swansea.

Dr. Mond was a well-read man of liberal culture and artistic tastes, broad-minded and tolerant, and of a judgment ripened by contact with leading men of all conditions and countries. His merits as a man of science and a technologist were widely recognised. He was an honorary graduate of universities at home and abroad; a Fellow of the Royal Society, and a member of the Accademia dei Lincei. He was president of the Society of Chemical Industry in 1889, and of the chemical section of the British Association in 1896. He was offered the presidency of the Chemical Society a year or so ago, a distinction he was unable to accept owing to the state of his health.

He died on December 11, 1909, in the seventy-first year of his age, and was buried at the St. Pancras Cemetery, East Finchley. T. E. THORPE.

We have received the following short statement of generous assistance afforded by Dr. Mond to the progress of science, in addition to the foundation and endowment of the Davy-Faraday Research Laboratory, of which we hope to give an account in another issue.

Dr. Mond did not restrict his benefactions in science to the direct encouragement of physical and chemical researches. He was an original member of the council of the British Institute of Preventive Medicine (which subsequently developed into the Lister Institute), and gave 2000*l.* towards its foundation in 1893. He also, three years ago, furnished 500*l.* for installing an apparatus for the investigation of caisson disease and of the problems of deep-sea diving. The work in connection with this investigation was carried on by Drs. Haldane and Boycott, and Lieut. Damant, and their results were published in the *Journal of Hygiene*, and in a report to the Admiralty. At Dr. Mond's suggestion, and with the aid of a subsidy from him, a research into the toxicology of nickel carbonyl, a substance he had himself discovered and put to practical use in the manufacture of pure nickel, was carried out by H. W. Armit, who published the results in two papers in the *Journal of Hygiene*.

In the year 1904 Dr. Mond contributed 10,000 lire towards the cost of erecting a laboratory and hostel at Col d'Olen in connection with the International Laboratory of Physiology on Monte Rosa, on the understanding that the Royal Society should have the permanent nomination to two posts in the laboratory.

Shortly after his election into the Royal Society in 1891, he gave practical effect to the deep interest which he felt in scientific bibliography. Indeed, but for his generous and active cooperation it would probably have been impossible for the Royal Society to continue its great undertaking of publishing a catalogue and index of the scientific literature of the last century.

In the second year of his fellowship of the Society Dr. Mond made a donation of 2000*l.* towards the cost of preparing the remaining material of the Catalogue and Subject Index of Scientific Papers, of which the third series was then approaching completion; and at the same time gave a promise of further assistance. This promise was amply fulfilled. Ten years later, in 1902, when the task of dealing with the mass of material published in the last seventeen years of the nineteenth century had to be faced, Dr. Mond offered 6000*l.* in four yearly instalments of 1500*l.* for the purpose of the completion of the catalogue and of the index. Again, in 1906, on the expiry of the four years, he gave a further 6000*l.* in three yearly instalments of 2000*l.* each for the same purpose; and, towards the end of the year 1908, he promised an additional donation of 2000*l.*, with the view of accelerating the publication of the catalogue, and more particularly of the three subject-index volumes for mechanics, physics, and chemistry.

Dr. Mond also took an active part in the inauguration of the International Catalogue of Scientific Literature, now in its seventh year of publication, and his interest in that undertaking continued unabated to the end of his life.

SIR ALFRED JONES, K.C.M.G.

OF all the "slings and arrows of outrageous fortune," I have not often experienced one sharper than the news of the death of Sir Alfred Jones. I am not sure that, broadly looked at, the loss of a battle would not have been more tolerable. For a defeat may be retrieved, but the loss of a commander may be irremediable.

This is to rate his loss pretty high, but not, I think, too much so. For the man was of a quality of which I have not met with the like in the past, nor do I expect to do so in the future. I cannot pretend that I knew him intimately, for he was of that Napoleonic sort which does not invite intimacy. But we were brought together by common interest in public work, where we each strove strenuously by different paths, and where success attended Jones more than could have been hoped for.

Part of the story is told admirably by a sympathetic hand in the *Times*. If I lift the veil a little further, the official indiscretion, if it be such, must be condoned in justice to Jones's memory. An old-fashioned firm, Elder, Dempster and Co. were the shipping agents of Kew in Liverpool. They carried on the trade with the West African colonies which has always been centred there; and in this firm Jones was originally a clerk.

But at the start these colonies were mere trading settlements on the coast which no one at home troubled about so long as they did not trouble. Then came the partition of Africa; the hinterlands were brought under British control, and a new problem immediately arose. If tribal wars are to cease, and an orderly government is to be maintained, a revenue to support it must be raised; and in the last resort this can only be achieved by the promotion of native agriculture and the supply of produce for an export trade.

With these ends in view, Kew succeeded in establishing a number of cheap botanical stations, where plants suitable for cultivation could be grown and propagated, and where the natives could learn cultural methods by inspection. The attempt, for the most part, was rather acquiesced in than encouraged by the colonial officials on the spot, and Jones was perhaps the first to impress spontaneously upon the Colonial Office its importance. He had by that time grasped the future of West Africa, had bought out his old masters, and placed West African trade on an entirely new footing. Incidentally he restored prosperity to the Canaries, and introduced the banana into England. Amongst the principal products of West Africa are various sorts of oil-seeds; for these Liverpool was hardly more than an *entrepôt*, as their principal market was in France. To utilise them at home, Jones started large oil-mills. All this, so far as it goes, only reveals the enterprise and sagacity of a far-seeing man of business; but his subsequent work for the West Indies shows a different side to his character.

The sugar-bounty system had crippled the sugar-industry in the West Indies, and there was much distress amongst the planters and population. In 1896 Mr. Chamberlain sent out a Royal Commission to report on the position, and I willingly assented to the Assistant Director, now Sir Daniel Morris, accompanying it as scientific adviser. I sat one evening under the gallery of the House of Commons to hear Mr. Chamberlain make an eloquent appeal for a subsidy in aid of the distressed colonies. It was passed without demur. But something more than temporary aid was needed, and in 1898 Morris left Kew on his appointment as Imperial Commissioner of Agriculture in the West Indies. On the eve of his departure, happening to be at the Colonial Office, I was told that it was desired to get in touch with Alfred Jones. At that time I had never even seen him, but I invited him by telegraph to meet Morris and the Colonial Office men at dinner. That night the Direct Line was virtually agreed upon. As Jones left he remarked to me that the dinner had only cost him a quarter of a million. Later on he wrote that he was having steamers built in every available yard in the kingdom. At a semi-official gathering this year, the last time I saw him, Jones remarked that the dinner was still not paid for. But throughout his object was not limited to commercial success. He wanted to do for the West Indies what he had done for the Canaries. Morris, by botanical stations and agricultural instructors, sought to turn the negroes into peasant cultivators; Jones to provide an outlet for the produce. But he did much more, and in order to attract tourists he took the defunct hotel industry in Jamaica into his own hands.

Jones was, of course, a man of business, but in no ordinary sense. Commercial success was necessary to him as a justification of his plans, but I think still more as supplying means for extending them. It is no affectation to say that he, of all men, thought imperially. To knit the interests of the home country, and not least of Liverpool, with those of our colonial possessions was the real aim of his life. He offered the Rhodes scholars a free passage from any port at which his ships were available, and one of his latest schemes was to send out parties of undergraduates to make the personal acquaintance of the West Indies. On his last visit to them he took out a large number of distinguished guests. The event was tragic: in the earthquake Sir James Ferguson was killed in the street, and Jones himself was only extricated from the ruins of a falling hotel by little short of a miracle. It may be feared that the strain and shock left effects which were unperceived at the time.

But two other even greater achievements must be mentioned. In 1890–1 I had succeeded in getting the cultivation of cotton experimentally tested in West Africa, and had had samples grown there valued at Manchester. But there the thing ended; it required a more vigorous impulse than mere demonstration. Jones habitually projected his ideas into the future. He saw that cotton-growing in the United States was limited by physical conditions, and could not be extended; that Indian cotton, for reasons too long to explain, was not available; and that the amount which the United States could spare must be a constantly diminishing quantity. He saw that fresh and independent supplies must be found. He virtually started the British Cotton-growing Association, and helped it to raise large funds, amounting to some quarter of a million. Jones possessed the electric power of stimulating more sluggish temperaments. With Morris's aid, cotton-growing was successfully re-established in the West Indies. Jones pushed it for all he was worth in West Africa, and Northern Nigeria promises to be the greatest cotton-growing area in the world.

The importance of this achievement, however, shrinks before that which was perhaps the most remarkable of all. So far as I know, Jones had no scientific training; but he had a fixed belief in the value of scientific knowledge. There are plenty of business men who are ready, so to speak, to pluck the pear when it is ripe, careless who grew it. But Jones looked confidently to scientific method to help on the solution of unsolved problems. If commerce was to be carried on with tropical countries, it must be possible for Europeans to live in them. From his point of view it was not sufficient to treat the local diseases; it was necessary to trace them to causes which could be obviated. He therefore, in perfectly simple faith, founded and endowed the Liverpool School of Tropical Medicine, and sent out one scientific expedition after another to investigate on the spot. Cattle rearing in the West Indies is hampered by diseases which are transmitted by "ticks." Jones sent out Prof. Newstead to study their life-history; he saw that if you could control the tick you could master the disease. But you cannot control the tick until you know everything about it. I could give a striking illustration of a more futile procedure by our own Board of Agriculture.

Jones had, in fact, the true scientific instinct. He knew nothing about science, but he thoroughly believed in the validity of its methods. It is for this reason that he deserves commemoration in these pages. There are probably men like him in America; they are certainly rare in this country; Mond may have been one, but then he was not of English birth.

As I have said, I did not know Jones intimately, and I have therefore been able to write of what he did only as I saw it from outside. He lived a strenuous life, and was a man of few words. The *Times* speaks in terms which I can well believe of his private generosity. I wrote to him on behalf of an orphan boy of promise in the village from which I write. Jones would promise nothing; but the boy got the post he desired in the engine-room of one of his ships.

Jones was a Welshman, and therefore, I suppose, a Celt. Perhaps to this he owed the buoyant optimism and that quality of imagination which is the primary element of success in science as in business. The great enterprises which he started probably possess sufficient momentum to continue; but the resourceful directing spirit is extinguished, and it is a national loss. He was not without honours amongst his own people in Lancashire. In 1901 he was created K.C.M.G. for his colonial services. But the distinction he most deeply prized was his election, without academic standing, as an honorary fellow of Jesus College, Oxford, a recognition which scarcely honoured the electors less than the recipient.

W. T. THISELTON-DYER.

NOTES.

WE regret to announce the death, on December 18, at Weybridge, of Dr. Shelford Bidwell, F.R.S., in his second-second year.

THE council of the Linnean Society has decided to devote the next meeting, on January 20, to a discussion on the origin of vertebrates, in which it is expected that Dr. Gaskell, Dr. Gadow, Mr. Goodrich, Prof. Starling, Prof. MacBride, Dr. Smith Woodward, and Prof. Dendy will take part.

The University of Paris has been authorised, we learn from the *Revue scientifique*, to accept the gift made last June by M. Henry Deutsch. The gift, which amounts to 500,000 francs, and yields an income of 15,000 francs, is to be devoted to the inauguration of an aërotechnical institute for the encouragement of research, having for its object the perfecting of machines for aërial navigation. The institute is to be established at the St. Cyr School, and it is hoped that it will be opened in May next.

The inaugural meeting of the Nature Photographic Society was held at the Institute of Science, Art, and Literature, Leeds, on December 11, Mr. J. J. Ward presiding. The primary object of the society is to form a fellowship among nature photographers in all parts of the world. The president is Mr. Richard Kearton, and the vice-presidents are Messrs. J. J. Ward, F. Martin-Duncan, H. Irving, and O. G. Pike. The secretary is Mr. Carl Edwards, Woodlesford, Leeds, who will be glad to supply particulars to all who are interested in the work of the society.

We learn with regret that Dr. Enrico Hillyer Giglioli, professor of zoology and director of the Royal Zoological Museum in Florence, died on December 16 after a short illness. Dr. Giglioli was commendatore of the Order dei Santi Maurijis e Lazzaro and of the Corona d'Italia, commandeur of the Franz Joseph Order and of the Mérite agricole, officer of the Instruction publique de France and of the Brazilian Order of the Rose. He was born in London on June 13, 1845, and completed his studies in Pisa in the year 1864. The following year he made a voyage of exploration on the Royal ship *Magenta*. In 1869 he was called to the University of Florence, where he was made extraordinary professor in 1871, and ordinary professor three years later. In 1896 he founded the collection of the Italian vertebrates, and later he published his "Avifauna italica," which reached its second edition in the year 1906. On December 20 Prof. Giglioli would have celebrated his fortieth year of teaching; and his death a few days before this proposed celebration has deprived his colleagues, friends, and pupils of the anticipated pleasure of offering him their congratulations upon his work. By the death of Prof. Giglioli one of the leaders of zoology, ornithology, and anthropology in Italy has passed into silence.

Mr. Otto Beit has made a munificent gift of 215,000*l.* for the foundation and endowment of medical research scholarships as a memorial to his brother, the late Mr. Alfred Beit. It may be remembered that some time ago Mr. Alfred Beit provided by his will the sum of 50,000*l.* toward the establishment of an institute of medical sciences. Owing to various circumstances the proposed formation of this institute was abandoned, and the moneys subscribed were returned to the donors or their executors. Mr. Otto Beit has now increased the sum thus received by him as his brother's residuary legatee to 215,000*l.*, which will yield by investment in trustee stocks an annual income of about 7500*l.* In his letter to the Senate of the University of London announcing this generous gift, Mr. Beit asks that the fund shall be named "The Beit Memorial Fellowships for Medical Research," and shall be devoted entirely to the furthering of medical research work in all its branches; or, as the deed of foundation states, "to promote the advancement by means of research of medicine and the allied sciences in their relation to medicine." Each fellowship is to be of the value of 250*l.* a year for three years, and "any man or woman of European descent, graduate of any approved university within the British Empire," will be eligible for election. The fund will be administered by a board of trustees consisting of Viscount Milner, Lord Curzon, Mr. R. B. Haldane, the principal of the University of London (*ex officio*), Mr. Otto Beit, Dr. J. K. Fowler, and Mr. B. F. Hawksley. The advisory board must consist of not fewer than five or more than seven men, all of whom must be members of the medical profession. The first members of the board are Sir T. Clifford Allbutt, K.C.B., F.R.S., Prof. J. Rose Bradford, F.R.S., Dr. J. K. Fowler, Dr. C. J. Martin, F.R.S., Prof. W. Osler, F.R.S., and Prof. E. H. Starling, F.R.S. The first election to the fellowships will take place on or before March 1, 1910, and on or about January 1 of each subsequent year. Except in special cases, the fellows may undertake research only at recognised places in London, so that the work to be promoted by the benefaction will be mainly carried out in institutions connected with the University of London.

When Dr. F. A. Cook returned from north polar regions four months ago and announced that he reached the North Pole on April 21, 1908, we expressed the hope that the observations of position and narrative of the journey would be published at an early date, so that the value of the claim could be decided definitely. In the absence of documentary evidence of this kind, the explorer's statements had to be accepted provisionally, but judgment upon them was reserved. At last the material upon which the claim to have reached the North Pole is based has been submitted to a committee of Copenhagen University appointed to investigate the records of Dr. Cook's journey. The conclusion arrived at by the committee is that the documents are altogether insufficient to prove the attainment of the highest northern latitude. A Reuter message from Copenhagen on December 21 states that the papers submitted to the committee for investigation were:—(1) A type-written report by Mr. Lonsdale on Dr. Cook's Arctic voyage, consisting of sixty-one folios. (2) A type-written copy of sixteen folios, made by Mr. Lonsdale, comprising the note-books brought back by Dr. Cook from his journey, and covering the period from March 18 to June 13, 1908, stated to have been written on the way from Svartevaag to the Pole and back until a place west of Heibergsland was reached. The committee points out, as a result of its investigations, that the afore-mentioned report of the journey is essentially identical with that published some time ago in the *New York Herald*, and that the copy of the note-books did not contain astronomical records, but only results. In fact, the committee remarks that there are no elucidatory statements which might have rendered it probable that astronomical observations were really taken. Neither is the practical side, namely, the sledge journey, illuminated by details in such a way as to enable the committee to form an opinion. The committee therefore considers that from the material submitted no proof can be adduced that Dr. Cook reached the North Pole. The council of the University accordingly declares as a result of the committee's report that the documents submitted to Copenhagen University contain no observations or explanations to prove that Dr. Cook on his last polar journey reached the North Pole.

The December number of the *Entomologist's Monthly Magazine* contains announcements of several additions to the British insect-fauna, among the most interesting of which is the brachelytrous beetle *Proteinus crenulatus*, obtained by Dr. D. Sharp at Netley Bridge in 1906, and again in 1907. In Spry and Shuckard's "British Coleoptera" three of the five European species are recorded as British; Dr. Sharp has been enabled to include the whole five in our fauna.

According to the report for 1908–9, the committee of the Leicester Museum and Art Gallery has sanctioned large and important additions to the buildings under its charge. The additions include a new entrance-hall, an extension of the main building, with the conversion of the greater portion of the ground-floor into a central hall, the replacement of the first floor by a gallery, and the construction of a new staircase. It is also proposed to erect and equip suitable work-rooms, to build a new wing on the west side of the present structure, and to devote the room now containing invertebrates to art purposes.

Circular No. 113 of the Entomological Bureau of the U.S. Department of Agriculture is devoted to the chinch-bug (*Blissus leucopterus*) and its ravages. No other insect indigenous to the western hemisphere has spread its devastating hordes over a wider tract than has this species, and were it not for the destruction of the larvæ by heavy rains, and, in a less degree, the diminution in its numbers by the attacks during the rainy season of a parasitic fungus, continuous corn-growing in many parts of the United States would have long since become impracticable owing to this insect. The present circular, after giving a detailed and illustrated account of the insect in its various developmental phases, summarises the history of its periods of greatest increase and its gradual spread, concluding with a description of the various methods which have been proposed to check and control its increase.

Nos. 1704 and 1705 of the Proceedings of the U.S. National Museum are devoted to molluscs, the first of these containing an account, by Mr. W. H. Dall, of a collection of marine shells from Peru, with a summary of the littoral marine mollusca of the Peruvian zoological province, while in the second Mr. P. Bartsch describes four new species of Philippine land-shells. In connection with the Peruvian province, Mr. Dall directs special attention to the unusual prevalence of black, blackish, or lurid colouring among the molluscs, this being particularly noticeable in the phytophagous group. It has been attempted to explain this phenomenon, which has long been known, by the suggestion that it is correlated with the presence of the vast beds of kelp so characteristic of the Peruvian coast; but it is pointed out that similar dark beds of kelp on the Californian coast give shelter to some of the most brilliant trochids and other molluscs, while green sea-weeds occur abundantly on the rocks below low-water mark on the coast of Peru. Evidently, therefore, some other explanation is required.

In a paper published in a recent number of the *Journal of Physiology* (vol. xxxix.) Dr. H. M. Vernon suggests a hypothesis of tissue respiration founded on ferment action. Dakin has shown that, in accordance with the well-known Fenton reaction, hydrogen peroxide, in the presence of ferrous sulphate as activator, is able to oxidise various amino-acids and fatty acids completely to carbon dioxide and water. Aldehydes are formed as intermediate products. Similarly in living tissues it is thought that intramolecular oxygen is taken up in the form of an organic peroxide and is transferred by the help of an intracellular peroxydase ferment to oxidisable substances. The presence of aldehyde groupings in animal tissues is strongly supported by the fact that poisons such as hydrocyanic acid, sodium fluoride and acid sodium sulphite, which are known to be capable of forming loose combinations with aldehydes, temporarily deprive the tissues of their respiratory power without necessarily doing them any permanent injury. Other poisons, such as formic aldehyde, temporarily prevent the tissues from forming carbon dioxide, though not from absorbing oxygen. It is suggested that they act by destroying peroxydase, so that the peroxide of the tissues, in the absence of activator, can only effect incomplete oxidations.

The study of nuclear changes and qualities in the mutants and hybrids of Œnothera offers a promising field of investigation. Mr. R. R. Gates, who has already contributed some papers on the subject, furnishes in the *Botanical Gazette* (September) a further account of the chromosomes in the hybrid *O. lata* × *O. gigas*. There are normally twenty-one (rarely twenty) chromosomes in the somatic cells as compared with fourteen in *O. lata* and twenty-eight in *O. gigas*. At the reduction stage half the germ-cells receive ten and half receive eleven chromosomes, but there are occasional irregularities, as when the germ-cells receive nine and twelve respectively. The author argues that this segregation is not a pairing and separation of homologous chromosomes of maternal and paternal origin, but merely a division into numerically equal groups.

Algology has formed the subject of several papers by Mr. F. S. Collins which have been published in *Rhodora* and other American publications. In his latest contribution, that appears as vol. ii., No. 3, of Tuft's College Studies, he undertakes the ambitious task of compiling a flora of the green algæ of North America. The bulk of the species are marine algæ collected on the shores of the United States, but the author recognises that Greenland, Canada, Mexico, and the West India islands fall within his province, and includes records of fresh-water algæ so far as they exist. The work contains short diagnoses of all the species, keys to the species, genera, and families, and a figure for each genus, thus providing a serviceable handbook for American algologists, and one that is likely to attract workers to the subject. The author distinguishes two main groups, the Heterokontæ, so-called because the motile cells have cilia of unequal length, and the Chlorophyceæ. The family of Desmidiaceæ is omitted, because it is too extensive.

We have received from Prof. Hergesell a preliminary summary account of the participation of various countries in the international kite and balloon ascents during the quarter ended June last. In addition to many places in Europe and the United States, ascents were made at Samoa and by the Greenland Scientific Expedition. The greatest altitude reached by registering balloons was 27,100 metres, at Munich on May 7. Heights of 20,000 metres and above were attained by the ascents from Glossop (Manchester), Hamburg, Strassburg, Uccle (Brussels), and Zürich. The meteorological results will be published elsewhere.

In addition to the elaborate monthly and seasonal meteorological charts of the Atlantic and Pacific Oceans issued by the U.S. Weather Bureau, to which we have already directed attention, we have received a copy of a handy "Marine Calendar," showing for each month the average weather conditions of the North and South Pacific, the storm and hurricane signal code, and the moon's changes for 120th meridian time (besides the usual almanac). Following the calendar are tables for the conversion of time of one country to that of another to the nearest second. The calendar will be found very convenient for the purposes intended, and will further popularise the useful marine work of the Weather Bureau.

An appendix to the report of the International Conference on Electrical Units and Standards of 1908 has just been issued. It will be remembered that the specifications of the ohm, ampere, and normal cell in the original report were expressed in general terms so as to admit of modifications in details at the various national standardising laboratories. The appendix now issued contains details of the methods adopted at the National Bureau of Standards of America, at the Central Electrical Laboratory of Paris, at the Reichsanstalt at Berlin, and at the National Physical Laboratory at Teddington. References to the literature of the subject are also given, so that this appendix will prove of great use in electrical laboratories.

THE *Naturwissenschaftliche Wochenschrift*, the organ of the German Society for Popular Science of Berlin, devotes almost the whole of its issue of December 4 to the first of a series of three articles on the experimental foundations of the atomic theory, by Mr. Werner Mecklenburg. After a short historical introduction the author deals with the evidence for the existence of discrete particles in optically clear colloidal solutions, and then goes on to the kinetic theory of gases as one of the means of determining the size of the actual molecule of matter. Under this head simple proofs of Boyle's law, of the relation between mean free path and viscosity, of Van der Waals's equation, and of Loschmidt's method of calculating the radius of a molecule are given. As the method of treatment of the subject is not unlike that adopted in Meyer's kinetic theory of gases, readers of the above weekly must be interested in science to a greater extent than the public generally gets credit for being.

MESSRS. BURROUGHS, WELLCOME AND CO., of Snow Hill Buildings, E.C., have issued their exposure record and diary for 1910. This pocket-book is so well known among photographers that the chief object of this note is to inform them that the 1910 issue is now ready. It is important to point out that three editions are issued and bound in different tints, according as they are especially arranged for the northern or southern hemisphere or for the United States of America. The pocket-book itself is a mine of practical information set up, so to speak, in tabloid form, and the concentrated essence of the contents, together with the pages for entering exposure records and for a whole diary, is all enclosed in a very neatly got-up covering which will stand constant wear and tear. It must not be forgotten that a very important feature is the mechanical exposure calculator, practically the simplest efficient instrument, which is fastened inside the back cover. One turn of one scale tells the correct exposure for any subject, at any time of the day or year, in any part of the world. The writer of this note has used one of these books for several years, and finds, to his regret, that to be without his copy means a great uncertainty in giving correct exposures. Issued at a price of one shilling, it is an extremely good investment.

A NEW apparatus has recently been installed in the mechanical engineering department of the Northampton Institute for testing aëroplane models, and is described in an article, by Messrs. C. E. Larard and R. O. Boswall, in *Engineering* for December 10. The apparatus consists essentially of a carriage supported on four wheels running on a long straight track, and carrying the model aëroplane. The carriage is drawn along with increasing velocity by means of a horizontal cord, which is attached to the carriage at one end and to a large drum at the other end. The drum is rotated by falling weights, and the velocity of the carriage at any instant is obtained from a record traced on a moving strip of paper by a vibrator making five complete vibrations per second. When a sufficient velocity has been attained the model lifts, *i.e.* flight begins, and the instant at which this occurs is marked on the strip of paper electrically. The velocity at which flight begins can thus be determined easily. The authors prefer this form of apparatus to the whirling-table method, and hope to make a series of tests on planes of varying shapes and dimensions. Experiments are now being made to determine the velocities at different angles, and also to show the manner in which the centre of pressure alters as the angle of the plane is varied. It is also proposed to instal a considerably larger apparatus than the existing one, which has a track 60 feet long at present.

THE twenty-sixth annual issue of the "Year-book of the Scientific and Learned Societies of Great Britain and Ireland" has been published by Messrs. Charles Griffin and Co., Ltd. The book has been compiled from official sources, and is intended to be a record of the work done in science, literature, and art during the session 1908–9 by numerous societies and Government institutions. In some cases the lists of papers read before societies are a little belated. For instance, it should have been possible in December, 1909, to publish the titles of papers read at the Winnipeg meeting of the British Association last summer in the place of those read in Dublin in 1908. Exhaustive though the list of societies is, it is not yet complete. Certain local geographical societies are dealt with, but the Geographical Association, with its numerous branches, receives no mention—an omission we have pointed out on a previous occasion.

OUR ASTRONOMICAL COLUMN.

DANIEL'S COMET, 1909*e*.—Dr. Ebell's ephemeris for Daniel's comet, 1909*e*, is extended to January 2, 1910, in No. 4376 of the *Astronomische Nachrichten* (p. 127, December 14), and the following is an extract therefrom:—

Ephemeris 12h. M.T. Berlin.

1909	α (true) h. m.	δ (true) ° ′	log r	log Δ	Brightness
Dec. 21	6 19·0	+45 34·7	0·2009	0·8022	0·92
,, 25	6 19·2	+48 15·8	0·2032	0·8128	0·87
,, 29	6 19·4	+50 40·7	0·2059	0·8255	0·81
1910					
Jan. 2	6 19·6	+52 47·8	0·2092	0·8404	0·74

The elements given by Dr. Ebell show a likeness to those calculated by Dr. Becker for comet 1867 I. (Stephan), which are given for comparison; the "period" given in the latter is 40·1±2·0 years. A number of observations are recorded in the same journal. On December 8 the comet was easily seen in the 8-cm. (3·2 inches) finder at the Uccle Observatory, and appeared to be of about magnitude 9·5; a nucleus of the twelfth magnitude and about 12″ in diameter was seen to be surrounded by a coma which was 3′ in diameter. Observers at Algiers and Arcetri on December 9 estimated the magnitude at 10·5 and 11·5 respectively.

HALLEY'S COMET.—Visual observations of Halley's comet with small instruments are now becoming common, and a number are recorded in No. 4376 of the *Astronomische Nachrichten*. Prof. Nijland reports that the comet was certainly visible in a 73-mm. finder on December 5, its magnitude being estimated as 11·0. Herr v. Buttlar, using a 3½-inch telescope on December 4, saw the comet as a nebulous mass of about 45″ diameter, having a magnitude of about 11·5.

SUBJECTIVE PHENOMENA ON MARS.—In No. 4358 of the *Astronomische Nachrichten* M. Antoniadi suggested, because it is not shown on photographs, that the dark band which surrounds the disappearing polar cap on Mars is probably a subjective phenomenon. In a later number (4363) of the same journal M. Jonckheere contested the subjectivity of a band which was irregular in form and might be obliterated from the photographs by the photographic "spreading" of the image of the brilliant polar cap.

To these suggestions M. Antoniadi replies, in No. 4376,

(1) that the irregularities are not in the band itself, but are due to a number of real, grey spots which are left isolated by the retreat of the disappearing cap; (2) that the distance of the dark band from the edge of the cap is too great to be covered by the "spreading" of the image of the latter. Further, he continues, if the phenomenon of the dark band is real, it should obey the ordinary laws of perspective, and should appear about two and a quarter times as broad at the extremities of the major axis of the projected cap as it does at the ends of the minor axis; but the majority of drawings show the band to be the same width all round, and M. Antoniadi therefore contends that it is a subjective effect produced by contrast.

TEMPERATURE CLASSIFICATION OF STARS.—In No. 4375 of the *Astronomische Nachrichten* Drs. Wilsing and Scheiner publish a list of 109 bright stars of which they have determined the effective temperatures by spectral photometric observations. The temperatures determined range from 2800° (absolute) for χ Serpentis, to 12,800° for λ Orionis, and, in a summary, the range from Vogel's type Ia1 to type III. is given as 9600°–3200°.

Dr. Nordmann, also, has recently published several notes, in the *Comptes rendus*, giving the results obtained by his method of photometric comparisons of various definite regions of the spectra. In No. 4 he gave a list of fifteen temperatures ranging from 2870° to >60,000° (absolute), and compared the order in which the stars were thus arranged with the order given, for the same stars, in Sir Norman Lockyer's temperature classification. The latter, of course, does not deal with actual temperatures, but in general the two arrangements were found to agree fairly well; Dr. Nordmann's value for the solar temperature also agrees well with the values determined by previous observers. In a later note confirmation of the temperature given for Algol was obtained by an independent method, whilst in the most recent publication (*Comptes rendus*, No. 23, December 26) Dr. Nordmann gives amended values of the temperatures primarily published. The only important alterations are found towards the upper temperature limit, and do not involve any rearrangement of the sequence; the highest temperature (for λ Tauri) is now given as >40,000°.

A NEW VARIABLE STAR, OR A NOVA.—In No. 4375 of the *Astronomische Nachrichten* Prof. Ceraski announces that on a plate taken on March 23, at 10h. 6m. to 12h. 6m. (M.T. Moscow), Madame Ceraski discovered an image of a tenth-magnitude object which is absent from twenty-four earlier plates, showing 12·5 magnitude stars, of the same region. The approximate position of this object is 8h. 29m. 26s., +53° 50′ (1900), and the shape of the image shows it to be a star; the suggested explanations that it might be a planet or an end-on meteor are thought to be improbable, and Prof. Ceraski suggests that all observers having plates of this region should examine them for traces of what may be either a nova or a new variable star.

THE "COMPANION TO THE OBSERVATORY."—Edited by Messrs. T. Lewis and H. P. Hollis, and published, at 1s. 6d., by Messrs. Taylor and Francis, this annual is the most generally useful, to the practical, general astronomer, of all the British annual publications. The issue for 1910 differs but little in form from its immediate predecessors, the usual contributions having been obtained from Mr. Denning, Dr. Maw, Mr. Crommelin, and M. Baillaud.

THE RELATION OF SCIENCE TO HUMAN LIFE.[1]

IN casting about for a suitable introduction for my address this afternoon, I came across some words written by a great Englishman, which with your permission I will read to you.

"Remember the wise; for they have laboured, and you are entering into their labours. Every lesson which you learnt in school, all knowledge which raises you above the savage and the profligate—who is but a savage dressed in civilised garments—has been made possible to you by the wise. Every doctrine of theology, every maxim of morals, every rule of grammar, every process of mathematics, every law of physical science, every fact of history or of geography, which you are taught, is a voice from beyond the tomb. Either the knowledge itself, or other knowledge which led to it, is an heirloom to you from men whose bodies are now mouldering in the dust, but whose spirits live for ever and whose works follow them, going on, generation after generation, upon the path which they trod while they were upon earth, the path of usefulness, as lights to the steps of youth and ignorance.

"They are the salt of the earth, which keeps the world of man from decaying back into barbarism. They are the children of light. They are the aristocracy of God, into which not many noble, not many rich, not many mighty, are called. Most of them were poor; many all but unknown in their own time; many died and saw no fruit of their labours; some were persecuted, some were slain, as heretics, innovators and corruptors of youth. Of some the very names are forgotten. But though their names be dead, their works live, and grow and spread over ever fresh generations of youth, showing them fresh steps towards that temple of wisdom which is the knowledge of things as they are; the knowledge of those eternal laws by which God governs the heavens and the earth, things temporal and eternal, physical and spiritual, seen and unseen, from the rise and fall of mighty nations to the growth and death of moss on yonder moors."

So spake Charles Kingsley, and his words I make use of as an introduction which strikes the key-note of what I have to say to you to-day.

The subject which I have chosen for my address—the relation of pure science, and especially of biological science, to human life, and inferentially the relation which ought to exist between pure and applied science in a college of science—is naturally of great interest to us in the Imperial College, which is a college of science and technology, and the purposes of which are, in the words of the charter, "to give the highest specialised instruction and to provide the fullest equipment for the most advanced training and research in various branches of science, especially in relation to industry." Particularly do I desire to set forth as clearly as I can the justification for including in a college which deals, not only with science, but with science in relation to industry, those branches of science which deal with organisms.

As industry forms the principal occupation of human life, and as the phenomena of organisms constitute the science of life, it may seem absurd to set out solemnly to justify the inclusion of the biological sciences in a college which deals with science especially in its relation to human life. Nevertheless, having regard to the fact that I have heard some doubt expressed as to whether the cult of the biological sciences properly falls within the scope of the Imperial College, it may not be out of place to bear the matter in mind on this, the second, occasion of the prize-giving of our new college.

What is the meaning of the word *science?* As in the case of so many words, its meaning has become confused by its partial application, *i.e.* by its application to a part only of its contents, and this has often led to a misapprehension of the relation of science and of the scientific man to life. Science simply means knowledge, and to speak of scientific knowledge, as opposed to ordinary knowledge, is to use a redundant phrase, always supposing that we are using the word knowledge in its strict sense. Huxley defined science as organised common sense, by which, I take it, he meant knowledge of things as they are—knowledge the reality of which can at any time be checked by observation and experiment; for common sense, if it is anything, is the faculty by which we are made aware of reality. Science is sometimes spoken of as exact knowledge, but I am bound to say that I do not like the phrase exact knowledge; it seems to imply an insult to the word knowledge. Its use reminds me of a friend of mine who, when he was offered one morning at breakfast a fresh egg, mildly asked, "In preference to what other kind of egg?" It recalls those regrettable phrases one so often hears, I *honestly* believe, or I *honestly* think; one wonders how the people who make use of them usually believe and think.

It must, I think, be admitted that science simply means knowledge, and that there is nothing peculiar about the knowledge of scientific men by which it differs from other knowledge.

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[1] Address delivered at the Imperial College of Science and Technology on December 16 by Prof. A. Sedgwick, F.R.S.

Scientific men are not a class apart and distinct from ordinary mortals. We are all scientific men in our various degrees. If this is so, how comes it that the distinction is so often made between scientific men and non-scientific men, between scientific knowledge and non-scientific knowledge? The truth appears to lie here: though it is true that all men possess knowledge, *i.e.* science, yet there are some men who make it their main business to concern themselves with some kind of knowledge, and especially with its increase, and to these men the term scientific has been technically applied. Now the distinctive feature of these men, in virtue of which the term scientific is applied to them, is that they not only possess knowledge, but that they make it their business to add to knowledge, and it is this part of their business, if any, which justifies their being placed in a class apart from other possessors of knowledge.

The men who make it their main business to add to knowledge may be divided into two classes, according to the motive which spurs them on. (1) There are those whose immediate object is to ameliorate the conditions of human life and to add to its pleasures; their motive is utility, and their immediate goal is within sight. Such are the great host of inventors, the pioneers in agriculture, in hygiene, preventive medicine, in social reform and in sound legislation which leads to social reform, and many other subjects. (2) There are those who pursue knowledge for its own sake without reference to its practical application. They are urged on by the desire to know, by what has been called a divine curiosity. These men are the real pioneers of knowledge. It is their work which prepares the way for the practical man who watches and follows them. Without their apparently useless investigations, progress beyond the limits of the immediately useful would be impossible. We should have had no applied electricity, no spectrum analysis, no aseptic surgery, no preventive medicine, no anæsthetics, no navigation of the pathless ocean. Sometimes the results of the seeker after knowledge for its own sake are so unique and astounding that the whole of mankind stands spellbound before them, and renders them the same homage that the child does the tale of wonderful adventure; such is the case with the work on radium and radio-activity, which is at present fixing the attention of the whole civilised world. Sometimes the work is of a humbler kind, dealing apparently with trivial objects, and appealing in no way to the imagination or sense of the wonderful; such was the work which led to and formed the basis of that great generalisation which has transformed man's outlook on nature—the theory of organic evolution; such was the work which produced aseptic surgery and the great doctrines of immunity and phagocytosis which have had such tremendous results in diminishing human pain. The temper of such men is a curious one; no material reward can be theirs, and, as a rule, but little fame. Yet mankind owes them a debt which can never be repaid. It is to these men that the word scientific has been specially applied, and with this justification—they have no other profession save that of pursuing knowledge for its own sake, or, if they have a profession, it is that of the teacher, which, indeed, they can hardly avoid. Ought such men, working with such objects, to find a place in the Imperial College?

It is a curious thing, but it has only comparatively recently been realised, that a sound and exact knowledge of phenomena was necessary for man. The realisation of this fact, in the modern world at any rate, occurred at the end of the Middle Ages; it was one of the intellectual products of the Renaissance, and in this country Francis Bacon was its first exponent. In his "Advancement of Learning" he explained the methods by which the increase of knowledge was possible, and advocated the promotion of knowledge to a new and influential position in the organisation of human society. In Italy the same idea was taught by the great philosopher Giordano Bruno, who held that the whole universe was a vast mechanism of which man, and the earth on which man dwells, was a portion, and that the working of this mechanism, though not the full comprehension of it, was open to the investigation of man. For promulgating this impious view both he and his book were burnt at Rome in 1600. You will find the same idea cropping up continually in the written records of that time; Copernicus gave it practical recognition when he demonstrated the real relation of the earth to the sun, and it was thoroughly grasped by our own Shakespeare, who gave it expression in the dialogue between Perdita and Polixines in the *Winter's Tale*:—

Perdita. The fairest flowers o' the season
Are our carnations and streaked gillyvors,
Which some call Nature's bastards: of that kind
Our rustic garden's barren; and I care not
To get slips of them.
Polixines. Wherefore, gentle maiden, do you neglect them?
Perdita. For I have heard it said
There is an art which, in their piedness, shares
With great creating nature.
Polixines. Say there be;
Yet nature is made better by no mean,
But nature makes that mean: so, o'er that art
Which you say adds to nature, is an art
That nature makes. You see, sweet maid, we marry
A gentle scion to the wildest stock and make conceive a bark of baser kind
By bud of nobler race: this is an art
Which does mend nature,—change it rather; but
The art itself is nature.

It is not difficult for us, though it may be difficult to our descendants, to understand how hard it was for man to attune himself to this new, this mighty conception, and the intellectual history of the last three hundred years is a record of the struggles to make it prevail.

Trained through long ages to believe that the heavens were the abode of the gods, who constantly interfered in the daily affairs of life and in the smallest operation of nature, it seemed to men impious to maintain that the earth was in the heavens, and to peer into the mysteries which surrounded them, and the endeavour to do so has been stoutly resisted; but the conflict, in so far as it has been a conflict with prejudice, is now over. It vanished in the triumph of the modern views on the origin of man which will be for ever associated with the names of Lamarck, Spencer, and Darwin.

The triumph of these views does not mean that they are correct or that we know anything more about the great mystery of life than we did before. He would be a bold and a prejudiced man who made that assertion. What it means is this, that man is grown up, that he has cast off the intellectual tutelage under which he has hitherto existed, that he has attained complete intellectual freedom, and that all things in heaven and earth are legitimate subjects of investigation. But it means even more than this; it means that the conviction is rapidly growing upon him that the only way in which he can hope to improve his condition is by understanding the laws, physical as well as spiritual, under which he exists, and this he is determined to try to do by the only method open to him—that of minute and arduous research.

And is it, I ask, an unworthy ambition for man to set before himself to understand those eternal laws upon which his happiness, his prosperity, his very existence depend? Is he to be blamed and anathematised for endeavouring to fulfil the divine injunction, *Fear God and keep His Commandments, for that is the whole duty of man?* Before he can keep them, surely he must first ascertain what they are!

We hear a great deal nowadays about the humanities and the humane studies—the study of "ancient elegance and historic wisdom"—and I should be the last to minimise in any degree the value and intense interest which is attached to the study of the writings and utterances of the mighty dead. They will always retain undimmed their attraction and inspiration for man, and man will always think with gratitude and affection of their authors; but it is possible to overdo a thing, and this talk of the humanities and humane studies has been overdone. After all, a live dog is better than a dead lion—but in this case we are dealing with a living lion.

It is ridiculous to say nowadays that the study of the humanities consists solely of the study of the writings and philosophy of the ancients; to take that view is to take the view of the schoolmen, the death-blow to which was given by Bacon and Bruno.

We have got beyond that; we claim that the true study of the humanities is a far wider thing—it is the study of the stupendous mechanism of the universe of which man forms a part, and the understanding of which is necessary for his happiness. That is the true humanity of which the other forms only a small portion. The time is coming when the principal preoccupation of man shall be the gradual disclosure of this mechanism and his principal delight the contemplation of its beauty. For remember what Plato himself said: the whole of nature, so far as it really exists, is a revelation of God.

In spite of the work and writings of such men as Bacon and Bruno in the end of the sixteenth century, the progress of science was at first but slow and the workers few. We have, of course, the immortal achievements of Newton and Harvey, and the foundation of the Royal Society, and the tremendous outburst of scholarship as typified in this country by Bentley and his co-workers; but the eighteenth century was, on the whole, characterised by intellectual quiescence both in scientific output and in literary creation. The quiescence was apparent rather than real. To borrow a metaphor from the garden, though there was little growth above ground, active root formation was going on. Linnæus (1707–78) was at work in Sweden creating the framework which rendered future work in botany and zoology possible; Buffon in France was cautiously feeling his way towards a theory of organic evolution; Henry Cavendish (1731–1810), Joseph Priestley (1733–1804), and Antoine Lavoisier (1743–94) were laying the foundations of modern chemistry; Albrecht von Haller (1707–77), Kaspar Friederick Wolff (1733–94), and John Hunter (1728–93), those of anatomy and physiology. The spade-work of these men, together with the improvement of the microscope, was necessary for the great outburst of scientific investigation which characterised the nineteenth century. Ushered in by the work of Cuvier (1769–1832), Lamarck (1744–1829), St. Hilaire (1772–1844), in biology, Thomas Young (1773–1829), Laplace (1749–1827), Volta (1745–1827), Carnot (1758–1823), in physics, it was adorned in its middle and latter period by the names of Davy, Faraday, Dalton, Arago, Richard Owen, Darwin, Lyell, Joh. Müller, Agassiz, Helmholtz, Stokes, Kelvin, and Pasteur.

The advance of knowledge is yearly becoming more rapid; if its steps were slow and hesitating in the seventeenth and eighteenth centuries, and if it quickened to a rapid walk in the nineteenth, we now hear the sound of a trot, which at the end of the century will be a gallop, and as the centuries succeed one another its pace will become even faster. Where will it lead us, and what will be the upshot for man?

But it is no part of my purpose to-day to give you an historical summary of scientific progress. The point I wish to illustrate is the vast increase in the scientific army and in the results achieved by them.

My thesis is that pure research into the sequence of natural phenomena is in itself of the greatest importance to the progress and welfare of humanity, and that a great statesman can have no higher aim than to solve the problem of how it may best be fostered. To what extent can such a thesis be justified by experience?

I might begin by examining the origin and progress of our knowledge of what is called current electricity, to which modern life, from a material point of view, owes so much. In illustration of what we owe to workers in electrical science I need only mention land telegraphy, ocean telegraphy, wireless telegraphy, telephones, electric light, electric traction, and our knowledge of radio-activity. The history of this science forms, perhaps, the best example of the importance to man of pure, apparently useless, scientific research, for at every stage of it, from Galvani's original observation through the discoveries of the Swede Oersted and of the Frenchman Ampère to those of our own Faraday and to the theoretical adumbrations of Clerk Maxwell and to the researches of Crookes on the passage of electricity through vacuum tubes, we meet with the investigation of phenomena which were apparently perfectly useless, and which to most practical men must at the time they were made have appeared as little more than scientific toys provided by nature for the harmless amusement of the queer people who meet in the rooms of the Royal Society and suchlike places where unpractical oddities resort. And yet I ask you to reflect upon the astounding results which have arisen from Galvani's observations made to discover the cause of the twitching of the frog's legs, and of Faraday's discovery of induction, and to indulge your imaginations in an endeavour to predict what may issue for man from Crookes's investigations of the glow without heat of the vacuum tubes.

But I have neither the knowledge nor the time to dwell upon the physical side of science. As in private duty bound, I must devote the short time at my disposal to examples culled from the biological sciences.

The great Frenchman Pasteur, in making a thorough examination of the process by which alcohol was obtained from sugar, discovered the part played by the organism known as yeast, and established the idea of organised ferment bodies. He extended his observations to other micro-organisms, and, in conjunction with his co-workers, among whom must be included those who were looking into the question of the spontaneous generation of living matter, definitely gave us the idea that putrefaction was caused by micro-organisms acting upon organic matter, that these micro-organisms are capable of resisting drought, and when dried float freely in the air and are distributed everywhere. When they fall upon a suitable material their vital activity is resumed, and they increase with incredible rapidity and set up putrefaction. It was reserved for our distinguished countryman Lister, then a surgeon in Edinburgh, to recognise the importance of these discoveries for surgery. Knowing of the researches of Pasteur and his fellow-workers, he conceived the idea that suppuration was due to putrefaction in the organic matter of the wounds caused by micro-organisms. Acting on this, he introduced his method of antiseptic surgery, by which his name has been rendered immortal. I think we may say that no single application of the results of pure research has done more to preserve human life and to diminish human suffering than this linking up by Lister of the putrefaction of suppuration with the work of his predecessors on the effects of the actions of micro-organisms upon organic matter. It is well to notice, in passing, that this discovery of Lord Lister's is a good illustration of the difficulty which the human mind has of conceiving even the simplest new idea. To us, now, how simple seems the step which Lister made; yet there were thousands of surgeons in the world who failed to make it, though they were continually dealing with suppurating wounds and wondering why they suppurated, and when it was made it was stoutly discredited by many quite able men.

I must now turn to another subject which is closely connected with the preceding, and well illustrates my thesis that pure scientific research, without reference to practical utility, is of the highest importance to mankind.

It will doubtless have occurred to many of you to ask the question, How is it, if the air contains floating in it the dried spores of multitudinous micro-organisms which only need a suitable medium for their development and increase, how is it that they do not obtain a lodgment in the healthy animal body, which one would think offers all the conditions necessary to their growth? It can easily be shown that the air we breathe, the water we drink, the food we eat, everything that we touch, swarms with these microscopic creatures; that they enter our lungs, that they germinate in our skin, that they occur in countless numbers in our alimentary canals, in short, that they are found everywhere on our body surfaces. How is it that they do not increase and turn our organs into a seething mass of putrefying corruption? One would expect that even if the skin and the membrane bounding the internal organs to which they obtain entrance incurred the slightest lesion, even a pin-prick, that they would have been able to enter. We know that after death they at once obtain complete dominion, and we therefore infer that in life there must be some protective mechanism in the body capable of dealing with them.

The discovery that there is such a mechanism was made in the early 'eighties by the distinguished Russian zoologist Elias Metschnikoff, though the need of its existence was not recognised by biologists in general until later. The result of this was that his remarkable discoveries were at first pooh-poohed and discredited by many, but ultimately they gained acceptance, and their further development in his own hand and that of others has wrought a revolution in the art of preventive medicine.

The mechanism consists of the small amœboid cells found in the blood, lymph, and body fluids generally, and called leucocytes, or white blood corpuscles. Though long known to exist, very little had been ascertained as to their function until Metschnikoff, working at such remote subjects as the embryology of sponges, the structure and digestion of polyps, the blood of water-fleas, realised that these small amœba-like cells, which exist in all organisms, actually swallow, digest, and so destroy small foreign bodies which have invaded the organisms. He called them the phagocytes, and all his subsequent work has been directed to the elucidation of their mode of action.

It is to Metschnikoff's work, prompted solely by the scientific spirit, that we owe our knowledge of phagocytosis and the great theory of immunity which has proceeded from it. It is impossible at the present moment to estimate fully the value to man of Metschnikoff's discoveries. Suffice it to say that they have already led to important practical results, and have revolutionised treatment.

I must now turn for a moment to another subject of the greatest importance to mankind, and one which has been brought into notice by the researches, perfectly useless so far as our material welfare is concerned, which were undertaken with the view of elucidating the great question of organic evolution. I refer to the study of genetics, which deals with the question mainly of the transmission of the properties of the organism; but it deals with even a larger subject than that. It looks into and tries to determine the laws which govern the origin of the characters of individuals, whether plants or animals, whether those characters have been acquired by inheritance or in some other way. The subject is of the utmost interest and practical importance to man from three points of view. It has a bearing on philosophy of a most important and far-reaching kind through the theory of organic evolution. That theory largely depends for its proof upon the science of genetics. Secondly, it has a most important bearing upon practical questions affecting breeders of animals and raisers of plants, and also upon man himself in connection with practical legislation. This brings me to the third point, in which this subject specially appeals to us, and that is what I may call its bearing upon ethics. This is, of course, closely connected with the last.

We are constantly confronted with questions in which we have to think, not only of the advantage and happiness of those alive at the present moment, but also of those not yet born who will succeed us on the earth. The decision of these questions is one of the most important and burning subjects which can be put before us. They often crop up in legislation, and yet we are quite unable to answer them because of the very little knowledge we possess of the laws which govern the transmission of characters from generation to generation.

The interests of future generations often appear to be in conflict with the immediate pleasure and happiness of the living, and we are confronted with the question whether we ought to give way to our own humane and benevolent feelings or whether we ought to set our teeth and deal ruthlessly with a number of people who must appeal to our pity, lest by saving them from elimination we should bring about an increase in the number of people who are unable to hold their own, and so weaken the nation and increase for the next generation the difficulties which we set out to cure. I do not pronounce any judgment on these questions; I merely wish to emphasise the immense, the transcendent importance, from the human point of view, of the investigations which the study of the question of evolution has caused biologists to carry out into that most difficult of all subjects, heredity, and of obtaining clear ideas upon the subject. These, I admit, are elementary examples, and probably familiar to most of you—and they might be largely added to from other branches of zoology, such as entomology, marine fauna, and physiology—of the great practical achievements which have followed from the recognition of the fact, possibly appreciated in some ancient civilisations,[1] but in modern times first understood by Bacon and his compeers, that natural phenomena are in themselves, and without reference to immediate utility, proper subjects of man's inquiry, and that all progress must be based on their thorough and accurate investigation.

The genesis of a new idea is so difficult, and the amount of work necessary for its complete elucidation and development so vast and detailed, that many eminent men, taking only a short period of time and not realising the minute steps by which the advance of knowledge takes place, have been led to doubt the value of scientific investigation in the higher realms of pure knowledge, even to the extent of speaking of the bankruptcy of science. Others, again, perceiving the apparent aimlessness of many investigations and undervaluing the motive which urges them on, have come to look with a certain contempt upon the man of pure science and his slow and plodding progress. What is the good of all this work at unimportant details? What do you get out of it, and what pleasure do you find in it? they ask, and when they are told that the humble worker usually gets nothing out of his work except the pleasure of doing it, and that his motive is nothing more elevated than the satisfaction of his curiosity, there does appear to be, it must be admitted, some justification for the contemptuous indifference with which the poor researcher is regarded by a considerable section of the population, as is shown by the almost entire absence of support of pure scientific research on the part of the Government. With the exception of an annual grant of 4000*l.* a year given to the Royal Society, I think I am correct in stating that the Government affords hardly any support to science save to such as is concerned with teaching or with some practical problem; and when one remembers the composition of Governments and the manner in which, and the reasons for which, they are chosen, one cannot unreservedly blame them for this attitude. The best method of fostering research is a difficult problem, and I can well understand that a modern democratic Government, depending as it does upon popular support with its attendant popular mandates, should shrink from dealing with it. To do so would bring them no popularity and no votes, and too often they are not really aware of its immense importance to human progress, and when they are they have great difficulties to face.

For it is impossible to organise research on a commercial basis. "All attempts," says Prof. Nichols, of Cornell, "at a machine-made science are doomed to failure. No autocratic organisation is favourable to the development of the Scientific Spirit. No institution after the commercial models of to-day is likely to be generously fertile. You can contract for a bridge according to specifications. No one, however, can draw up specifications for a scientific discovery. No one can contract to deliver it on a specific day for a specified price, and no employee can be hired to produce it for wages received."

This it is impossible to get the public to understand even when it has undergone the process which we call education. You may establish paid posts for scientific research, but you cannot be sure that you will get research, for science is like the wind that bloweth where it listeth, and that is what our educated public do not like. They want something for their cash, and they will not wait.

Even those who are aware of the immense value of pure research forget the fact that the aptitude for scientific investigation is as rare as the gift of poetry, to which in many respects it is allied, for both are creative gifts, rare and precious. They forget that it is impossible to ascertain without trial whether a man possesses it or not, and that this trial can only be made when he has passed his student days and looks to support himself by his own exertions. To provide for this support money is needed, and studentships must be established in considerable numbers, from the holders of which those who show that they possess the gift of research can be selected and promoted to higher posts in which their gift can find full opportunity; but we want more than this—we want compensation for those whom we have encouraged to make the trial and who have failed to show that they possess the gift, and an outlet by which they can emerge and find work in practical life.

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[1] There are, as is well known, indications that research into natural phenomena was practised and esteemed in some ancient civilisations which have been destroyed by the inroad of barbarians or by other causes. One of the most striking of these indications is the record in one of the sacred books of the Hindus which cannot be less than 1400 years old, and is probably much older, that malarial fevers are directly caused by the bite of mosquitoes. Attention was first diected to this record by Sir H. A. Blake, G.C.M.G., in 1905, while he was Governor of Ceylon (*vide* Journal of the Ceylon Branch of the British Medical Association, vol. ii., part i., 1905).

This has been and is a difficulty in all schools of science, for many are called but few are chosen. The situation is this: it is desirable that a large body of able young men should be encouraged to take up scientific research, but as experience has shown that only a small proportion of them will possess the qualities by which success in research can be attained, and as it is undesirable to encumber the progress and the literature of science by a host of workers who have no real capacity for research, it results that a time will arrive when a great proportion of those whom we have encouraged to give some of the best years of their life to this unremunerative work should be invited to find other occupations. What is to be done? We cannot throw them into the street. Some compensation must be given. There are two ways in which this can be done. One is the system of prize fellowships, which has for long been in vogue at the old universities, and which it has of late been the custom of those who have not really studied the matter to decry. Nevertheless, it is a good system, for it provides an income by which those who have given some of the best years of their life to this trial of their capacity can support themselves while they qualify for taking part in a practical profession.

A prize fellowship system, or something like it, is a necessary accompaniment of a university which induces a large number of young men to follow for a time the intellectual life; it acts both as an inducement and a compensation, and it would be a mistake and an injustice, in my opinion, to abolish it; but there is another way in which the difficulty can be met, and that is the way which has been adopted by the wise and far-seeing founders of the Imperial College, namely, by the combination of a school of science with a school of technology. If you have incorporated in your school of science a school of applied science, and if you at the same time take care that none but able men are allowed to enter the research grade, and if you establish, as you must do if you honestly work your school, a connection with the great industrial interest of the country, you have all that is necessary for the disposal of those men who, for whatever reason, find themselves unable to follow a life of pure science. As is well known, the faculty for pure, apparently useless, research in science is often possessed by men without any aptitude for practical application of science or desire of practical success and the wealth which practical success brings, while, on the contrary, many minds of the highest order cannot work at all without the stimulus of the thought of the practical outcome of their labour.

In our college there is room both for those with the highest gifts for pure scientific research and for those with the inventive faculty so important in the arts, or with the knowledge and ability for controlling and organising great industrial enterprises; and, what is more, the combination of the two types of mind in the same school cannot but be of the greatest advantage to both, not only on account of the atmosphere which will be created, so favourable to intellectual effort, but also because good must result from the contact in one school of minds whose ultimate aim is to probe the mysteries of nature and to acquire control over her forces.

As Prof. Nichols has well said in pointing out the dependence of technology on science:—"The History of Technology shows that the essential condition under which useful applications are likely to originate is Scientific productiveness. A country that has many investigators will have many inventors also. . . . Where science is, there will its by-product technology be also. Communities having the most thorough fundamental knowledge of pure science will show the greatest output of really practical inventions. Peoples who get their knowledge at second hand must be content to follow. Where sound scientific conceptions are the common property of a nation, the wasteful efforts of the half-informed will be least prevalent." These are sound conclusions, and experience has shown that if the terms are interchanged the same remarks may be made with equal truth of the good influence which results to a school of science from its association with a school of technology.

Before concluding, it may be well to say a word as to the origin of the great imperial institution in the interests of which we are met here to-day. It may justly be described as the natural and necessary outcome of the scheme for scientific instruction which was originated by that great Prince whose memorial stands near the end of Exhibition Road, and to whom science and art in England owe so much. He dreamed a dream which his untimely death alone prevented him from realising. Had he lived, who can set a bound to what he would have achieved for science and education in England? It is a most happy circumstance that the final stages of the realisation of that dream should have been entered upon in the reign, and have received the sympathy, patronage, and active support of his great son, our most gracious King, who is working in so many directions for the welfare and happiness of our race.

There is one further point I must touch upon. In the few remarks which I have had the honour to make to you, I have endeavoured, however imperfectly, to embody in words certain thoughts which bear upon a great subject. I thank you for the patience with which you have heard me. Whether I have produced the effect I desire I know not, but I know this, that even if I had the tongue of men and angels, no words of mine could have been so apt, so expressive as the magnificent deed of Mr. Otto Beit recorded in to-day's newspapers. It is impossible for me to pass this over in silence, so closely is it connected with the subject of my address. There are two ways of manifesting thought, by word and by action. Mr. Beit has chosen the latter and far more effective way. We can only express our respectful admiration and gratitude for his generosity, and our thankfulness that a man should exist among us with the power, the insight, and the true humanity to do such a splendid deed.

THE NEW DEPARTMENT OF BOTANY AT UNIVERSITY COLLEGE, LONDON.

ON Friday, December 17, the new botanical laboratories at University College, London, were formally opened by Dr. D. H. Scott, F.R.S., the Vice-Chancellor of the University of London (Prof. M. J. M. Hill, F.R.S.) presiding. Dr. Scott, in the course of a very interesting address, said that botany has been more fortunate in that college than in many others of more modern origin, for the subject has always been recognised from the foundation of the college as an independent science co-equal with her sisters. In the long period from 1828 to the present time there have only been three appointments to the chair, viz. Profs. Lindley and Daniel Oliver, and the present occupant, Prof. F. W. Oliver. After giving an outline of the history of the department and of his own connection with it, Dr. Scott spoke of the various branches comprised in the subject. Systematic botany is the oldest branch, but it never can become old-fashioned. It is not needed less now than a century ago. At one time there was a tendency to neglect it somewhat in favour of the study of the structure and functions of some few plants which have been favoured with selection as types. Now the pendulum has swung the other way, and its importance is fairly recognised in teaching. It would be disastrous if systematic botany fell into neglect, and it would be peculiarly discreditable to English people, because systematic botany is specially a glory of this country.

Referring to the Hookers, Bentham, C. B. Clarke, and Daniel Oliver, Dr. Scott said it would appear to be a characteristic that the ablest minds have been attracted towards systematic botany. Comparative anatomy, he said, is now pressed into the same service as systematic botany. Comparative anatomy is particularly a study of the modern English school. These two branches are now subservient to questions of evolution, the search for relationships having become identified with the attempt to race descent. It is from this point of view that the English school of anatomy has been directed, and this has led to a close union with fossil botany, the direct investigation of the historical documents of the rocks, so often best recorded in anatomical characters. In this way the modern study of fossil botany, based chiefly on structure rather than on the often deceptive external appearances of the fossils, has been active in an advantageous way in recent times, and has given it a more truly comparative and evolutionary character than it ever had before. After referring to physiology, ecology, and cytology, Dr. Scott expressed the view that genetics, the study of variation and heredity, is probably the leading subject of all at the present day. It is the subject by which this age will be remembered, though the study is only actively beginning now. The impetus given by Darwin, already felt in many other directions, is only beginning to be felt in this particular direction.

A vote of thanks was moved by Lord Reay (chairman of the college committee) and seconded by Prof. F. W. Oliver, who, on behalf of the members of the department of botany, presented to Mrs. D. H. Scott a piece of jewellery as a souvenir of the occasion.

The opening ceremony was attended by a numerous company of botanists, members of the University Senate, college committee, and professorial board. The exhibits shown in the rooms of the new department included portraits of former members of the staff, a selection of records connected with the ecological work of the department at the Erquy station, fossil plants from the groups of the Pteridospermeæ and Cycadophyta, and other work connected with the work of the department.

The following is a description of the new department, which takes the place of a series of inconvenient and indifferently lighted laboratories in the central building.

The suite of rooms now allotted for the accommodation of the department of botany has become available through the transfer of the department of physiology to new quarters in the south quadrangle. Built in 1878, under the supervision of the late Sir J. Burdon Sanderson, for purposes closely similar to those to which they are now being put, it has not been found necessary to make any structural alterations of moment.

In all, fifteen rooms are included in the department; they are situated on either side of a corridor which runs the whole length of the top floor of the north wing of the college. The rooms have been allocated as follows:—

On the north side, following the lecture-room, is the professor's laboratory, and adjoining this the elementary and advanced laboratories. These two rooms have been thoroughly overhauled, and staging has been erected so that the working tables get the full benefit of the excellent lighting. The benches are arranged in four tiers, and are fitted with water, gas, and electric lamps. Each of these laboratories has seating capacity for forty students. Beyond these rooms is a large room set apart for original investigations, especially in anatomical and microscopic work. The available space is increased by the existence of a gallery along the south side with separate windows. Communicating with the research room is the chemical physiology room, with benches equipped for twenty-four workers. As in the research room, there is a gallery lighted from the south, and suitable for special investigations.

On the south side of the corridor the rooms are all top-lighted in order to conform with the style of architecture in which the façade of the college has been built. The first room on this side has been fitted up as a departmental library, in which the collection of pamphlets, numbering about 4000, has just been classified, and is now about to be catalogued.

Next the library comes the large apse room, which will be used as a herbarium and ecology room. Here are being arranged the ecological collections and photographs, vegetation charts, &c., connected with the field work of the department at Erquy and elsewhere, together with biological specimens generally. The overhead lighting of this room makes it very suitable for the examination and exhibition of specimens, and for mapping and similar purposes. The concave apsidal end of this room has been fitted with a continuous, semi-circular desk for demonstrations and temporary exhibits—a purpose for which it is well suited.

Next to the ecology room, the old animal room has been converted into a central store for preserved material of all sorts. On one side of this store potting benches have been erected for the service of a small conservatory which lies beyond. This greenhouse will be used as an adjunct to physiological work and for raising plants for class purposes.

INDIAN GUILD OF SCIENCE AND TECHNOLOGY.

ON Saturday, December 18, a large number of Indian students assembled at the University of Leeds to inaugurate an Indian Guild of Science and Technology. This movement is the outcome of the noteworthy migration of Indian students during the past three or four years to countries where they seek to equip themselves with scientific and technical knowledge to aid in the development of Indian industries. The object of the Guild is to promote intercourse between these students and to assist them in every possible way to attain their common aim. The members hope, by associating themselves in this way, to assist other incoming students, and to cooperate, when they return, in promoting science and its applications to industry and sanitation. They hope also to stimulate an organised movement in India with these objects.

The meetings on December 18 were attended by students from a considerable number of centres of higher education, and the proceedings were marked by unanimity and enthusiasm. At a preliminary meeting the general constitution of the Guild was drawn up. In the afternoon the inaugural meeting was held, when Prof. A. Smithells, F.R.S., was elected president for the year, and delivered an address. Prof. Smithells outlined the work which he thought the Guild might accomplish, and enlarged upon the importance of science in relation to the development of the resources of India and the improvement of the condition of the people. He insisted upon the importance of not allowing an educational system to arise which should lead intelligent Indians mainly to the destiny of lawyers and clerks, and he maintained that India could not at this day develop its industries without a much greater application of science than there had been in the early days, or was even at the present time in Great Britain. Though there were many signs of scientific activity in India, and much excellent work was being done by the Government, he thought that a national effort among the younger men of the country might do much towards aiding the existing agencies.

Lord Airedale, as a representative of the iron and steel industries, who for more than half a century had been associated with a large manufacturing concern, made an interesting speech, in which he recalled examples of the benefits conferred by science upon industry. He urged his hearers not to let their poetic imaginations run away with them, but to apply themselves practically and industrially to the attainment of scientific knowledge, and then to concentrate on one or two definite objects.

Among speeches made by the students was an eloquent plea, by Mr. R. N. Sen, for regaining the lost glory of India by the assimilation of all that is best in western scientific and technological knowledge.

In the evening the members of the Guild assembled at an inaugural dinner. Many encouraging messages had been received from men of science, including the presidents of the Royal Society, the British Association, the Institute of Chemistry, Sir Henry Roscoe, Prof. Witt, of Charlottenburg, Prof. P. C. Rây, of Calcutta, Sir Alex. Pedler, Prof. Meldola, Prof. Dunstan, and others. Lord Airedale, Sir Henry Roscoe, Sir W. Ramsay, K.C.B., and Prof. O. N. Witt were elected patrons, and the following were elected sectional hon. presidents:—Prof. Schäfer, F.R.S. (Edinburgh), Prof. Barr (Glasgow), Prof. Procter (Leeds), Prof. Cadman (Birmingham), Prof. Knecht (Manchester).

The subscription to the Guild is 10*s.* entrance fee and 10*s.* annual subscription. The secretary is Mr. M. A. R. Paniker, The University, Leeds.

THE PHYSICAL SOCIETY'S EXHIBITION.

THE fifth annual exhibition, which was held by the Physical Society of London at the Imperial College of Science and Technology last week, was marked by some pleasing innovations. Hitherto the exhibition has been limited to the evening only, but on this occasion it was open also in the afternoon, and this extension of time was evidently appreciated. Experimental lectures were also introduced. Thus many visitors must have welcomed the opportunity of seeing once again the beautiful and well-known experiments on soap bubbles by Prof. C. V. Boys, F.R.S., as they have not been seen during the last ten or fifteen years. In the evening Prof. S. P. Thompson, F.R.S., showed the remarkable effects obtained by combining mica and selenite viewed under polarised light.

Turning to the exhibits themselves, we may remark that there were about forty exhibitors, and for this reason it is impossible to do more than give a brief reference to some of the more interesting and novel exhibits in the space at our disposal. In the subject of mechanics, in its broadest sense, Mr. W. V. Gilbert's anticlastic levers, shown by Messrs. Strange and Graham, received the most attention. The device is known by the trade name of "Vilcars," and enables a movement in a given plane to produce a movement in a plane at right angles, although no joints or complicated links are used for producing this change in the direction of motion.

Among other mechanical devices we may mention the Wimperis accelerometer, shown by Messrs. Elliott Bros. (see NATURE, December 2, p. 139). The acceleration is indicated by a pointer, which moves on a scale suitably graduated. The indication is effected by an eccentrically placed copper disc which is controlled by a hairspring and is magnetically damped. By a special gear and balance weight the disc is compensated so that the instrument is affected only by acceleration in one direction, which is indicated by an arrow on the dial. A simpler type of instrument is that due to Mr. A. P. Trotter, and shown by Messrs. Everett, Edgcumbe and Co. This consists simply of a curved glass tube nearly filled with liquid, and is best described as a spirit-level of extravagant curvature. When subjected to acceleration along its length the position of the bubble varies according to the acceleration. Obviously it may be used equally for measuring gradients.

The principle of the diffusion of gases is brought into practical use in the gas-leakage indicator shown by the Cambridge Scientific Instrument Co. An elastic metal chamber is closed by a porous tile, so that the pressure within it increases when the instrument is brought into an atmosphere containing light gas, such as coal gas. The pressure is shown by a pointer, the motion of which is an indication of the presence of gas.

There was a good display of optical apparatus, including microscopes, cameras, and photometers. Among the latter may be mentioned the daylight illumination photometer due to Mr. A. P. Trotter, and exhibited by Messrs. Everett, Edgcumbe and Co. In testing the illumination of a room by daylight, an absolute figure in, say, candle-feet is not of value by itself, because it depends upon the brightness of the day on which the measurement is made. This difficulty is overcome by using a vertical tube placed over the screen which receives the illumination to be measured. The instrument is first placed where a clear view of the zenith is obtained, and a stop is inserted in the tube so as to cut down the illumination to a convenient figure. A measurement is then made in the room where desired, the tube having been removed. The stops are so proportioned that the true ratio of the illumination in the room to that in the open is readily obtained. As examples of such measurements the makers mention that the ratio over the Speaker's chair in the House of Commons is 0·0009, and that in the British Museum reading room 0·007.

Electrical exhibits were by far the most numerous, and among these perhaps the most interesting was the application of Abraham's rheograph (shown by the Cambridge Scientific Instrument Co.) to throw on the screen a hysteresis loop. It will be remembered that in the rheograph a light aluminium frame is suspended in a permanent magnetic field, and forms the secondary of a small transformer. The controlling and damping forces are made relatively unimportant, so that the deflection becomes proportional to the current or potential difference under observation. On the present occasion two vibrators were arranged at right angles, one to give a deflection proportional to **B** and the other to **H**. A beam of light being reflected first from one and then from the other therefore gave a hysteresis loop, which appeared quite steady upon the screen.

The same firm showed Dr. C. V. Drysdale's slip meter, which, although it has been in use for some years at the Northampton Institute, has not, so far, been generally available. A circular card, on which certain geometric figures are printed, is fixed to the shaft of the machine under test, and is observed through a stroboscopic disc. The latter is driven frictionally by a conical roller, which in turn is driven by a small synchronous motor. By moving the disc along the roller its speed is varied, and when the geometric figures on the card appear stationary the speed can be read off on the graduated leading screw which controls the position of the disc. This part of the apparatus is quite small and compact. Depending on the arrangements used, speed, frequency or slip can be determined.

Messrs. Snell and Tinsley showed one of Dr. C. V. Drysdale's potentiometers for alternating currents, the difficulty of phase difference being eliminated by a "phase shifter," by which the phase of the current in the potentiometer wire is made to coincide with that of the pressure to be measured. A rotary field is produced in the phase shifter by splitting up a single-phase current into two in quadrature.

Duddell's vibration galvanometer, which is a modified oscillograph, was shown by Messrs. Nalder Bros. and Co. Messrs. J. J. Griffin and Sons exhibited Mr. Tucker's high-potential primary battery; it is compact in form, and appears to give its 1000 volts with a minimum of trouble. Mr. F. Harrison Glew showed a radium collector for atmospheric electricity. This consists of a metal spiral coated with insoluble radium salts; it is suspended in an elevated position from a weather-proof insulator, and as the radium ionises the air around it the wire acquires the potential of the atmosphere, and gives an indication on an electroscope.

Visitors also had an opportunity of seeing one of the latest methods of transmitting photographs electrically, as exemplified in the apparatus of Mr. T. Thorne Baker, shown by the *Daily Mirror*. Prof. Korn's method, with selenium cells, has reached a stage of some perfection, but the smallness of the currents available in such a method introduces difficulties. There is thus a tendency to use rather more mechanical methods. In Mr. Baker's apparatus, photographs are printed on fish-glue upon lead foil, and lines are drawn across this so as to expose the lead. The style comes into contact more or less with the lead, depending upon the density of the image, and thus allows current to flow into the line. At the receiver the picture appears on suitably prepared paper by electrolytic action, and the results seem to be very satisfactory.

The exhibits we have enumerated by no means exhaust all that was of interest, but want of space renders a complete survey impossible.

EXPERIMENTS ON COMPOUND STRESS.

TWO papers dealing with experiments on compound stress were read at the Institution of Mechanical Engineers on Friday, December 17. The first of these, by Mr. William Mason, of the University of Liverpool, gave the results of tests made by the author on mild steel tubes, and included tests made in simple compression, in simultaneous compression and hoop tension, in simple axial tension, simultaneous axial and hoop tension, simple axial compression, and simultaneous axial and hoop compression. Two sizes of tubes were used, viz. 3 inches bore and 2·75 inches bore, of thickness about 0·08 and 0·128 inch respectively. The larger tubes were cold-drawn, and the others were hot-drawn. Some of the tests were made on the tubes unannealed, in others the tubes were annealed. Extensometers of the Ewing type were used in measuring the strains. The testing machine employed was the 100-ton Buckton machine in the Walker Engineering Laboratory. Hoop tension and compression were obtained by applying hydraulic pressure to the inside and outside of the tubes respectively; in the latter case a special jacket surrounded the tube under test. The experiments show an approximate agreement between the maximum shear stress at the yield point in compression and the yield-point stress in pure shear, the mean difference in the tests of annealed specimens being about 3 per cent. It appears, then, that mild steel in compression yields by shearing; and, to a first approximation, the value of this shear stress is independent of any normal compressive stress on the planes of the slide.

The second paper was contributed by Mr. C. A. M. Smith, of the East London College, University of London. Solid mild steel test specimens were used under combined tension and torsion, and also under combined compression and torsion. The 50-ton machine at the college was used, and the strains were measured by means of the author's sphingometer, by means of which readings are obtained on three planes at 120 degrees. The results obtained give further confirmation of Guest's law for mild steel. The author's remarks regarding the difficulty of obtaining axial application of the load, both with pull and push, were of special interest. Ordinary wedge grips are of little use in securing this; even spherical seatings are bad. Sphingometer readings with the latter show great divergence from regularity in the strains on three planes, although the means are perfectly regular. Often in a test the ball joints slip into new bearing positions, thus producing a new eccentricity of the load. These facts emphasise the necessity of employing an instrument of the sphingometer type in tests of a scientific character for loads within the yield point.

THE PARASITES OF THE GROUSE.

SOME valuable results of the work of the Grouse Disease Inquiry Commission are published by Dr. A. E. Shipley, F.R.S., in a series of papers on the parasites of the red grouse (Proc. Zool. Soc. Lond., 1909, pp. 309–368, plates xxxv.–lx.), in which the ectoparasites, the thread-worms, and the tape-worms are successively described and illustrated.

Ninety per cent. of the birds examined were infested with two species of Mallophaga (*Goniodes tetraonis* and *Nirmus cameratus*) which feed on the barbules of the feathers. "The number on each bird is to some extent an inverse measure of their health." Though not a parasite, the larva of the common dung-fly (*Scatophaga stercoraria*) is described and excellently figured—a noteworthy contribution to the scanty literature on larval Diptera—because it was hoped that these maggots, which are found in numbers among the droppings of the grouse, might prove to be intermediate hosts for the grouse tape-worms; the results, however, were entirely negative. With the same object in view, the crops of many grouse were examined, and although gamekeepers and sportsmen believe that these birds eat no insects, their animal food was, in fact, found to be "fairly abundant and very varied," comprising caterpillars of moths and saw-flies, frog-hoppers and Diptera, spiders and slugs. Although no bladder-worms were found by these investigations, Dr. Shipley has incidentally thrown light on the feeding habits of the grouse, and has shown that mere external observation in such questions is often to be distrusted.

The grouse tape-worms, the cysticercus stages of which are thus still unknown, comprise a larger species (*Davainea urogalli*) and a smaller one (*Hymenolepis microps*). This latter, "so transparent when alive as almost to be invisible," is nevertheless very abundant in the duodenum, where its presence appears to be often fatal to the birds, so that it is a far more serious pest than its larger companion.

Of the Nematoda that infest the grouse, *Trichosoma longicolle* and *Trichostrongylus pergracilis* are the most important, and the latter of these, at least, requires no intermediate host for its development. By soaking heather and then centrifuging the drawn-off water, Dr. Shipley showed that "heather is, so to speak, crawling with thread-worms"; the means by which the nematode larvæ, hatched from eggs passed out of the birds' intestines, enter the food canal of new hosts is thus plain. Another fact of interest is the presence of larval thread-worms in the lungs and liver; these are believed to be derived from eggs hatched while still in the intestine of their parents' host-bird, and to wander through the latter's body. Readers who have followed Dr. Shipley's recent suggestions as to the importance of parasitic worms in certain human diseases will be prepared for his belief that these wandering larval nematodes may be responsible for pathological conditions in the organs of the grouse.

G. H. C.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The general board of studies has appointed Mr. L. A. Borradaile to be university lecturer in zoology from January 1, 1910, to September 30, 1914.

It is proposed, in accordance with the recommendation of the special board for moral science, to appoint a syndicate to make arrangements for the building of a laboratory of experimental psychology.

DR. J. L. SIMONSEN, assistant lecturer and demonstrator in chemistry in the University of Manchester, has been appointed professor of chemistry in the University of Madras, and Dr. A. Holt has succeeded him at Manchester.

A LECTURE by some man eminent in letters, science, or art, to be delivered annually in the Lent term, has been established at Queen's College, London. Her Majesty the Queen, patron of the college, has allowed it to be called the Queen's lecture.

UNDER the Irish Universities Act, 1908, graduates of the Royal University of Ireland may be registered as graduates of the National University of Ireland. We are asked to announce that as the first meeting of Convocation must take place within six months from the date of the dissolution of the Royal University of Ireland, it is very advisable that application for registration as graduates should be made without delay. All information may be obtained from Dr. Joseph McGrath, registrar of the University, the National University of Ireland, Dublin.

COURSES of afternoon lectures on aëronautics will be held after Christmas at the Imperial College of Science and Technology. Sir George Greenhill, F.R.S., will lecture on the dynamics of an aëroplane; Mr. H. R. A. Mallock, F.R.S., on fluid resistance; and Colonel H. C. L. Holden, F.R.S., on light petrol motors for aërial work. The courses will begin respectively about the middle of January, the early part of February, and after Easter. Research scholarships will be awarded by the college to advanced students desirous of undertaking research work in scientific problems connected with aëronautics. The scholarships are to be tenable for one year at the Imperial College, and provision may be made for part of the work to be undertaken at the National Physical Laboratory. Scholars will be entitled to free admission to the college and to a maintenance allowance.

THE next annual conference of teachers arranged by the London County Council will be held on January 6–8 inclusive at Birkbeck College, Chancery Lane, London. Among the subjects for discussion, we notice that during the afternoon of the first day the training of engineers will be dealt with. Sir William White, K.C.B., will preside, and addresses will be delivered by Prof. D. S. Capper on the training of engineers, by Dr. R. M. Walmsley on the sandwich system as applied to day engineering students, and by Mr. R. Bunting on higher elementary education and the preliminary training of engineers. The next afternoon Sir Lauder Brunton will preside, and the teaching of domestic economy will be discussed. Mr. John Wilson will deliver an address on the correlation between the teaching of domestic economy and experimental science. Other subjects of discussion will be:—the organisation of higher schools; the teaching of number; methods of teaching in schools for the mentally defective, and educational experiments in schools. No charge is made for admission, and tickets may be obtained from the Chief Inspector, Education Department of the London County Council.

LA LIGUE DU L'ÉDUCATION FAMILIALLE was founded in 1899, with the cooperation of the Belgian Government, to secure closer association between parents and teachers in the study and practice of educational methods. An international congress was held at Liége in 1905 to discuss the relationship of home life to education in school and college. A second similar congress was held in Milan in 1906. At the request of the Belgian Government a committee has been organised to bring to the attention of the British public the third International Congress, to be held in connection with the Brussels Exhibition, August 21–25, 1910. The Marquess of Londonderry has accepted the presidency of the committee, and Mr. Walter Runciman, President of the Board of Education, and Mr. Charles Trevelyan, Parliamentary Secretary to the Board, have been appointed vice-presidents. The necessity for intimate association of home and school influences if we are to obtain efficiency in education is becoming increasingly recognised, and the committee desires that parents and teachers will take full advantage of such an interchange of opinion as is offered by this congress.

THE prize distribution at the Imperial College of Science and Technology, South Kensington, on Thursday, December 16, was chiefly noteworthy for the interesting address by Prof. Sedgwick, F.R.S., on scientific research, reprinted in another part of this issue. Lord Crewe, the chairman of the governing body, presided, this being the first occasion on which he has attended this annual function. In his opening remarks the chairman referred to the resignations of the rector (Dr. Bovey), Sir William Tilden and Prof. Gowland. The proceedings were enlivened by numerous interruptions from students of the Royal School of Mines, who, by shouting the name of the school, demonstrated that the individuality of the school has not been lost by the establishment of the Imperial College, of which it forms an "integral part." The vote of thanks to Lord Crewe for presiding was proposed by Sir Julius Wernher and seconded by Mr. Arthur Acland, who stated that the governing body has set aside the sum of 12,000*l.* for the establishment of a students' club. Lord Crewe, in responding, appealed for a double loyalty among the students—for their respective colleges on the one hand, and for the Imperial College on the other, the relation of which to the component colleges he compared to that of his own University of Cambridge to the Cambridge colleges. The associateship of the Royal College of Science was granted to forty-four students, and the associateship of the Royal School of Mines to thirty-four students.

THE Mathematical Association and the Association of Public School Science Masters will hold their annual meetings next January in common, to a large extent. The meetings of both associations are to be held at Westminster School. On January 12, 1910, the Mathematical Association will hold its own meeting in the morning, when, after the business part of the agenda has been completed, addresses will be delivered by Mr. C. Godfrey on different methods in algebra teaching for different classes of students, by Prof. P. J. Harding on elliptic Trammels and Fagnano points, and by Mr. W. J. Dobbs on a patent inexpensive balance. During the afternoon of the same day a joint meeting will be held of both associations for the consideration of the report of the committee on the correlation of mathematical and science teaching. On January 13 the science masters will hold their annual meeting. The president for the year, Prof. H. E. Armstrong, F.R.S., will deliver his address, taking for his subject "The Future of Science in Our Schools." Afterwards Mr. Eccles, of Gresham's School, Holt, will read a paper dealing with the confusion existing in the symbols used in text-books on physics, and urging that some uniform system be introduced. In the afternoon Mr. L. Cumming, of Rugby School, will read a paper on the desirability of teaching all boys geology or biology during some portion of their school life; Mr. Cross, of King's School, Peterborough, will deal with laboratory equipment and design, and Mr. Oldham, of Dulwich College, on teaching oxidation and reduction. The usual exhibition of books and apparatus will be held.

THE annual prize distribution of the Sir John Cass Technical Institute was held on December 16, when the awards were distributed by Dr. H. A. Miers, F.R.S., principal of the University of London. In the course of his address, Dr. Miers pointed out that success in competition is to be regarded as a special gift, because it is not everyone who is born to succeed in competing with his fellow men and women, and, moreover, success is not to be measured by the faculty of excelling others. No pleasure can surpass that of success in one's own work, and the problem in modern life is how to combine this conscious spirit of pleasure and pride in work with the totally different conditions in which it is carried out now as compared to those which existed in the old days of the guilds and apprenticeship in the City of London. The aim of technical institutions should be to make the students less of specialists and to give them more versatility and adaptability so as to enable them to find out new ways of pursuing their own work. It is true that in order to effect this many subsidiary subjects of study are necessary, but such subjects should be regarded as only representing the different principles of the more special subject of study, and should be worked out with enthusiasm and keenness from the point of view of their bearing upon the specific science or industry in question. New methods of work which may have a bearing in many directions of science are not made as accessible as they should be, owing to the extreme difficulty of reading research papers outside one's own special subject, a difficulty due to the fact that those who are pursuing scientific research and are studying scientific methods do not devote sufficient attention to expressing themselves in simple English. The student who goes out into the world with a keen interest, not only in his special work, but also in the other subjects which he had to learn as a student, and with some knowledge of the general principles underlying them all, will never feel helpless when he finds himself in new conditions and confronted by new problems. In conclusion, Dr. Miers pointed out that no educational work could be quite successful unless it is inspired by the spirit of research, and he welcomed the encouragement of research in the Sir John Cass Technical Institute, referring especially to the prizes awarded by the Goldsmiths' Company in metallurgy, and to the award by the Institution of Mining and Metallurgy of the "Consolidated Goldfields of South Africa premium of forty guineas" jointly to Mr. C. O. Bannister, the head of the metallurgy department, and to Mr. W. N. Stanley, a student in the department.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 9.—Sir Archibald Geikie, K.C.B., president, in the chair.—W. J. **Young**: The hexosephosphate formed by yeast-juice from hexose and phosphate.—L. S. **Dudgeon** and H. A. F. **Wilson**: On the presence of hæm-agglutinins, hæm-opsonins, and hæmolysins in the blood obtained from infectious and non-infectious diseases in man (third report). These results are based upon some hundreds of experimental observations which have been made upon normal and pathological blood, and are as follows:—(1) Auto-agglutination of the red blood cells, as tested for by the methods which we have employed, may be shown to occur with specimens of pathological blood only occasionally, but never with normal blood; and auto-hæmolysis has not been met with. (2) Iso-agglutination is often met with in specimens of blood obtained from patients suffering from the same disease. (3) Hæm-agglutination is largely a specific phenomenon, both in normal and pathological blood, and the specific effect can be shown to persist even if the red cells have been subjected to high degrees of temperature or to complete drying. (4) Hæm-agglutination and bacterial agglutination are distinct phenomena. (5) Well-marked isohæmolysis in specimens of normal and pathological blood is not common, although some degree of hæmolysis can frequently be demonstrated. (6) Concerning phagocytosis: It would appear necessary to avoid mixing specimens of normal or pathological blood, because just as samples of sera are known to vary in value, so do the leucocytes, although to a less extent, whether they are obtained from specimens of normal or pathological blood. Still further, by mixing samples of normal or pathological blood a hæmolytic action may be induced which in itself has been found capable of exciting abnormal results in phagocytosis. (7) It appears to be incorrect to regard a specimen of blood as normal until it has been subjected to a detailed examination by the methods referred to in this and the two previous communications, quite irrespective of its actual source.—L. **Doncaster**: Gametogenesis of the gallfly *Neuroterus lenticularis* (*Spathegaster baccarum*), part i. The cynipid *Neuroterus lenticularis* has two generations in the year, hatching in April and June. The April generation consists of females only, which lay parthenogenetic eggs. Evidence is given that some of these flies lay only eggs destined to become males, other flies only eggs which become females. The June generation thus consists of males and females; the eggs are fertilised and give rise to the generation which appears in April. In the spermatogenesis 10 chromosomes are found in the spermatogonial mitoses. In the spermatocytes, the first maturation division is abortive, only a small piece of cytoplasm with the centrosome being separated. In the second spermatocyte division 10 chromosomes appear and divide equally into the spermatids. The two spermatids are similar, except that one receives a small extra-nuclear body absent in the other. Somatic mitoses in the male show 20 chromosomes, except in the nerve-cells, which appear to contain 10 only. The eggs of the June generation undergo a double but irregular maturation division, apparently leaving 10 chromosomes in the pronucleus. Segmentation divisions in these eggs and body-cells in females of both generations show 20 chromosomes. The study of the maturation of the eggs of the spring (parthenogenetic) generation is not yet complete, but suggests that the eggs of some females undergo maturation and chromosome-reduction; those of others undergo no reduction. It is suggested that the former eggs yield males, the latter females. These observations, combined with (1) those of the author on the relation between sex and a somatic character in the moth Abraxas, (2) with the inheritance of such cases as colour-blindness, and (3) with the sex-relations of "heterochromosomes" in insects, lead to a hypothesis as to the nature of sex. It is suggested that there are male and female sex-determinants (symbols ♂, ♀) which behave as Mendelian characters, each being allelomorphic with its absence (symbol ⊙). Females have constitution ♀ ♂, and produce ♀ eggs and ♂ eggs; males have constitution ♂ ⊙, and produce ♂ and ⊙ spermatozoa. ♀ eggs are fertilised by ♂ spermatozoa, yielding females; ♂ eggs by ⊙ spermatozoa, yielding males.—Dr. E. **Schuster**: Preliminary note upon the cell lamination of the cerebral cortex of echidna, with an enumeration of the fibres in the cranial nerves.—Dr. F. W. **Mott**, Dr. E. **Schuster**, and Prof. W. D. **Halliburton**: cortical lamination and localisation in the brain of the marmoset. This research is one which has been carried out on lines similar to that previously published by two of the authors in relation to the brain of the lemur. A series of sections of the cerebral cortex has been examined in order to map out the extent and boundaries of the types of cell lamination observed. It is now well known that these differences are correlated with differences in function, and this method of histological localisation of function (as it may be termed) has been controlled by the physiological method of stimulation.—R. H. **Whitehouse**: The caudal fin of fishes (preliminary paper). The paper communicated is a summary of a fuller work on the caudal fin of fishes in general, but principally the Teleostei. It aims at a revision of the definitions of terms in general use, in order to disperse the vagueness surrounding these terms. Diphycercy is shown to be very vague, inasmuch as it does not specify the primary or secondary nature of the symmetry, and thus it may be dispensed with in favour of protocercy and gephyrocercy, the former of which implies primary, and the latter secondary, symmetry. Concerning heterocercy, the essential features of this condition are considered to be (1) an enlarged lower lobe, and (2) the retention of individual centra, when formed, to the end of the axis. The term "hypural" is introduced into this form, since there is evidence of these structures being formed by the union of radials and hæmal arches. Under homocercy, three varieties of fin-structure are discussed for the purpose of showing (1) the breadth of the term, (2) features which determine the degree of specialisation, and (3) the taxonomic value of the caudal. Evidences of caudal abbreviation are reviewed, and a re-defining of the term "epural" is given, by which this structure is considered the dorsal homologue of the ventral hypural. The presence of radials dorsally and ventrally is directed attention to, and also the composite nature of hypurals and epurals. Finally, evidence is given in support of the theory that the permanent homocercal caudal is a shifted anal, and, moreover, support is forthcoming among the Elasmobranchs.—H. E. **Arbuckle**: Some experiments with the venom of *Causus rhombeatus*.—Dr. V. H. **Veley** and Dr. A. D. **Waller**: The comparative action of stovaine and cocaine as measured by their direct effects upon the contractivity of isolated muscle. As tested by an independent method, these two drugs are found to be of approximately equal physiological action in correspondence with their affinity values.—Sir David **Bruce**, Captains A. E. **Hamerton**, H. R. **Bateman**, and F. P. **Mackie**: *Glossina palpalis* as a carrier of *Trypanosoma vivax* in Uganda.—Prof. W. M. **Hicks**: A critical study of spectral series, part i., the alkalies, H and He.—G. W. C. **Kaye**: The distribution of the Röntgen rays from a focus bulb. A Röntgen bulb was constructed with an antikathode the inclination of which to the beam of kathode rays could be varied at will. The bulb as a whole was also capable of rotation, and thus by the use of a stationary ionisation chamber, intensity distribution curves could be obtained for the X-rays. The hardness and intensity of the Röntgen rays were found to be almost independent of the obliquity of the antikathode. Some possible improvements in the modern focus bulb are suggested in the paper.—R. D. **Kleeman**: The direction of motion of the electrons ejected by the α particle. When an α particle collides with a molecule, we should expect that the direction of motion of the ejected electron depends on that of the α particle. If the whole or a part of the energy of ionisations is derived from the α particle, the electron should have a component of motion in the same direction as the direction of motion of the α particle. Some experiments to test this showed that when α particles are shot through thin metal foil more electrons are given off from the side of the foil where the α particles emerge than where they enter. This shows that the motion of the liberated electrons is on the whole in the same direction as that of the ionising α particle.—F. **Soddy** and A. J. **Berry**: Conduction of heat through rarefied gases. By the aid of the calcium absorption process of producing high vacua, the conductivity of twelve gases for heat has been determined at pressures so low that the actual path of the molecule is comparable with its mean free path (*cf.* Sir W. Crookes, Proc. Roy. Soc., 1880, 31, 239). By an electrical method the heat dissipated from a platinum strip, maintained at 61° in the gas, has been measured at various pressures down to a thermally perfect vacuum. As indicated by the kinetic theory, the heat dissipated at low pressure is proportional to the pressure, whereas at higher pressures it is independent of pressure. It was found that the conductivity in the first case bore no relation to that in the second. At all ordinary pressures hydrogen and helium are easily the best conductors, while of the gases examined carbon dioxide was the worst. At low pressure the conductivity of acetylene, methane, and cyanogen somewhat exceeded that of hydrogen, while helium was but slightly better than carbon dioxide. At low pressures the conductivity will be defined in terms of the calories ($x\ 10^{-5}$) dissipated per second, per 0·01 mm. of pressure, per sq. cm. of surface, per 1° difference of temperature between the surface and the wall of the containing vessel. The symbols K and Q will be used to express respectively the experimental and calculated values of the conductivity so defined. On the assumption that the heat interchange between the molecule and the surface it impinges upon is perfect, Q is the product of the number of impacts of the molecules per second per sq. cm. and the specific heat of the molecule. By the aid of the kinetic theory, Q may readily be approximately calculated from the mean molecular velocity and the molecular heat at constant volume. In the table the gases have been arranged in ascending order of K. In the second column, which gives the relative conductivity of the gas at ordinary pressures, the figures refer to the watts dissipated by the gas in the apparatus at pressures such that conductivity was independent of pressure. In the last three columns the values of K, Q, and of the ratio of K to Q, are given.

	Watts.	K.	Q.	K/Q.
Argon	1·07	1·30	1·20	1·09
Neon	2·35	1·76	1·70	1·04
Carbon dioxide ...	0·95	1·89	2·64	0·72
Oxygen	1·55	1·91	2·23	0·86
Helium	7·30	1·94	3·80	0·51
Carbon monoxide ...	1·37	1·96	2·38	0·82
Nitrous oxide ...	0·97	2·11	2·75	0·77
Nitrogen	1·44	2·21	2·35	0·94
Hydrogen	8·75	2·29	8·95	0·25
Cyanogen	0·97	2·35	—	—
Methane	2·81	2·70	3·95	0·68
Acetylene	1·24	2·75	3·82	0·72

For argon and neon the agreement between the observed and calculated conductivity is as good as can be expected, whereas for all the other gases the ratio is less than unity, and in the case of hydrogen and helium the divergence is especially marked. The results appear to afford the means of obtaining information concerning the nature of the single impact of the gas molecule with a surface. Whereas for the denser monatomic gases the interchange of energy appears perfect, for the more rapidly moving molecules of helium and hydrogen this is not the case. The results are preliminary, and the conclusions now tentatively suggested are being tested further with improved apparatus.—T. **Wright**: Harmonic tidal constants for certain Chinese and New Zealand ports.—S. **Kinoshita**: The photographic action of the α particles emitted from radio-active substances. The photographic action of α rays is quite distinct from that of light. There is no diminution in the action when the rays are screened by an absorbing substance, so long as they are capable of passing through the photographic film. In the case of light, the action varies with the intensity of the light, which decreases on passage through an absorbing screen. The photographic action of α rays is thus independent of the velocity of the rays and depends on the number of α particles, N, which passes through the film and can be expressed, when measured by the density, D, as

$$D = D_{max}\left(1 - e^{-CN}\right), \text{ where C is a constant.}$$

This formula can be theoretically deduced on the assumption that each halide grain is rendered capable of development when struck by a certain number of α particles. By counting the number of silver grains in the film exposed to a known number of α particles, it was found that each halide grain was rendered capable of development when struck by a single α particle. The mass of silver per unit area of a developed film, calculated from the number of grains and their average size (deduced from the constant, C, in the above equation) by a consideration of the theory of probability, agrees well with the value determined from the density and the photometric constant. The sensitiveness of a photographic film to α rays cannot be characterised by its inertia. A rapid plate is more sensitive to α rays than a slow plate, if density be taken as a criterion. The reverse holds, however, when the number of grains is considered, provided that the total amount of silver halide per unit area is the same in both cases. The authors have now this new method of counting single α particles, in addition to the electrical and scintillation methods. The photographic method should prove very valuable for counting very small numbers of α particles, since it is applicable to very weak sources by using very long exposures, and also to α particles having a very short range.—Hon. R. J. **Strutt**: The accumulation of helium in geological time, III. The present experiments refer to the amount of helium in zircon. This mineral is found in igneous rocks of all ages, and the experiments show clearly that the quantity of helium generated closely follows the geological age. This must not be taken to prove that they retain the whole of the helium generated within them by radio-active change, but rather that, as they all crystallise from fusion, they are all of similar structure, and retain a not very different fraction of the full quantity of gas in each case. The following table summarises the results. The last column shows the ratio of helium to radio-active matter (c.c. per gram of uranium oxide), thoria being reckoned as equivalent, in helium production, to 0·203 times its weight of U_3O_8:—

Locality.	Geological Age.	Per Gram of Zircon.			Helium Ratio
		Helium cc. × 10^{-4}	U_3O_8 Grams × 10^{-8}.	ThO_2 Grams × 10^{-4}.	
Vesuvius	Tertiary ...	<0·4	38·0	—	<0·01
Campbell I., New Zealand	Tertiary ...	0·807	3·17	8	0·223
Mayen, Eifel	Tertiary ...	1·14	12·7	0	0·090
Expailly, Auvergne ...	Tertiary ...	2·12	3·72	0	0·570
N.E. Tasmania	?	4·34	1·14	0	3·88
Brevig, Norway	Post Devonian	98·8	13·3	32·7	4·94
Cheyenne Cañon, Colorado	Palæozoic ...	193	12·8	11·4	12·8
Green River, Henderson Co., N. Carolina	Palæozoic ...	255	12·9	30·1	13·4
Ural Mts.	Palæozoic ...	300	6·34	46·5	19·0
Kimberley Diamond Mines	Palæozoic ...	323	10·8	1·32	29·2
Ceylon	Ancient ..	210	6·57	19·8	19·8
Ceylon	Ancient ...	283	10·1	4·0	26·0
Ceylon	Ancient ...	575	75·3	28·5	7·1
Sebastopol, Renfrew Co., Ontario, Canada	Archæan ...	114	1·83	0·92	56·6

Royal Anthropological Institute, December 14.—Mr. H. Balfour, past-president, in the chair.—E. **Torday**: Results of a recent ethnographical expedition to the Congo Free State. The expedition left England in October, 1907, and travelled by the Kasai and the Sankuru to the Ba-Songe country. The Ba-Songe are a tribe of the Ba-Luba people, whose affinities lie rather to the south. The next tribe visited was the Ba-Tetela, a cannibal people who occupy a large extent of country between the second and fifth degrees of southern latitude. These people seem to have been extending, gradually but steadily, south and west from the Lower Lomami. Their culture is interesting as exhibiting a transition between that of the forest and of the plains. Other tribes visited were the Bu-Shongo, the Akela, and the cannibal Ba-Nkutu, who seem to have cultural affinities with the northern Ba-Tetela. The Ba-Songo Meno, a term given to a large number of tribes on both banks of the Kasai between the Sankuru and the Mfini, were also visited. These tribes have never been investigated, and show great hostility to the white man. The western Bu-Shongo tribes were also visited. These people, originally migrants from the north, gained most of their culture from the tribes to the west, and it was with these people that the paper chiefly dealt, including the Ba-Kongo and the Bashi Lele, who represent the first waves of Bu-Shongo immigration into the country. With regard to history, it is a remarkable fact that the Bu-Shongo people have preserved their records. The name means people of the Shongo, the shongo being a weapon, now obsolete, which was the principal arm of offence in the early days. The chief drew a picture of this weapon in the sand, and it was unmistakably a throwing knife. Now the throwing knife as a weapon does not occur south of the great bend of the Congo. The argument, therefore, that the people originally came from the north is strengthened by this fact, as the north was the original home of the weapon. From evidence of language, tribal history, and culture, the original home of the people seems to have been the west central Sudan. The remainder of the paper dealt with the institutions, government, and religion of the people. The tribal organisation is extremely elaborate. At the head is the chief, but in certain points his mother appears to take precedence. There are also six great officers and a host of other officials. Although nominally absolute, the chief has little real power. The right to the throne descends in the female line, but a woman can only come to the throne if the male stock fails.

This is the theory. In practice the chief has the power practically of nominating his successor, as he can disinherit any likely claimant. In religion the Bu-Shongo believe in an all-powerful creator, but they pay no worship to him. Magic is largely practised. The spiritual nature of man is considered to consist of three elements, soul, double, and shadow. The soul only leaves the body at death, the double at both death and sleep, and the shadow only at death, the belief that a corpse cannot cast a shadow being current among the people. The nearest approach to true totemism as yet discovered in Africa was found among the western Bu-Shongo, where each person inherits from his father an Ikina, a plant or animal which he may not eat. This Ikina has no connection with tribal names, and the division into Ikina cuts across the division into tribes and villages. Persons possessing the same Ikina may not marry.

Royal Meteorological Society, December 15.—Mr. H. Mellish, president, in the chair.—Dr. W. N. **Shaw**, F.R.S.: The variations of currents of air indicated by simultaneous records of the direction and velocity of the wind. In order to form a mental picture of the changes which are taking place in the amount of air flowing past an anemometer, we need to take into account the changes of direction as well as the changes in velocity. The author had endeavoured to combine these in what he called a "vector diagram," and he pointed out some interesting results which he had obtained from such diagrams.—W. G. **Reed**, jun.: A critical examination of South American rainfall types. The object was to make a simple yet accurate map showing the seasonal distribution of rainfall in South America.—W. G. **Reed**, jun.: The study of phenomenal climatology. The suggestion has several times been made that treatment of weather elements by days and months is arbitrary and unnatural for places not within the tropics. The author points out that in latitudes subject to cyclones the distribution of weather elements depends largely upon the relation of cyclones and anticyclones, and he therefore suggests that the cyclone is a more rational unit than the day or the month.

Edinburgh.

Royal Society, December 6.—Prof. Cossar Ewart, F.R.S., vice-president, in the chair.—Dr. D. C. L. **Fitzwilliams**: The short muscles of the hand of the agile gibbon (*Hylobates agilis*), with comments on the morphological position and function of the short muscles of the hand of man. The material was supplied by the late Prof. Cunningham. The extraordinary length of the upper limb of the agile gibbon, and the manner in which it uses the hook-like hand as it swings itself from tree to tree, have an influence upon the anatomy which can be clearly recognised, especially in regard to the muscles. Thus in the gibbon the muscles of the hand tend to wander down the phalanges. This is evidently a mechanical gain, and is a response to the demands of function. The paper contained an elaborate comparison of the layers of muscles in the hand of the gibbon with the arrangements in the human hand, the discussion being based upon the distribution of the three primitive layers which, according to Cunningham, characterise the typical mammalian manus.—G. **Green**: Waves in a dispersive medium resulting from a limited initial disturbance. Following up a former paper on group velocity, the author investigates the effect of the same initial disturbance in all media in which the velocity of an infinite train of regular waves is proportional to the wave-length. The results obtained are similar to those given by Prof. Burnside for water waves in his paper on deep-water waves resulting from a limited original disturbance, of which the paper is an extension. It is shown that in all the media considered the greatest disturbance at each point is inversely as the square root of the distance of the point from the place of the original disturbance, and the wave-length of the disturbance when greatest is the same for every point, being determined entirely by the form of the initial disturbance.—Dr. W. A. **Caspari**: The composition and character of oceanic Red Clay. The chemistry of this deposit, though it has received attention from several investigators, still presents uncertainties. At Sir John Murray's suggestion a re-investigation of the whole subject from the chemical standpoint was undertaken. Moreover, Sir John Murray's unique collection of deep-sea deposits afforded the opportunity of choosing a highly representative series of red clays from all parts of the world. The methods and the results of analysis are given in detail. Regarding the general question of the molecular constitution of submarine clays, the author concludes that these hydrous silicates are not so much definite chemical compounds or mixtures of such as agglutinates of colloidal silica, alumina, &c., in inconstant proportions. What the affinity is which binds the constituents together we do not know, but it is certainly not exclusively chemical. In the Red Clay areas we have a temperature of 1° C. to 3° C., pressures of 400 to 600 atmospheres, and a uniform medium (sea-water), conditions which give to deep-sea weathering features which sharply contrast with subaërial weathering. The degradation product has much the same composition all over the globe, and it is a more acid silicate than the corresponding continental material. Clearly silica can escape into the hydrosphere just as well as alkalies and alkaline earths. On the whole, there seems to be something approximating to a genuine equilibrium between Red Clay and sea-water. When the colloidal nature of Red Clay is realised, the invariable presence of calcium, magnesium, and alkalies causes no surprise. This retention of highly soluble matter may be ascribed to capillary action at the enormous surfaces presented by the fine grains of clay and their internal framework, but the possibility that chemical affinities are also exerted is not to be disregarded. Potassium, calcium, magnesium, and sodium are withdrawn, in approximately constant proportions, out of the sea-water. The order given is the order of their adsorbability, and is just the reverse of their abundance in sea-water.

Paris.

Academy of Sciences, December 13.—M. Bouchard in the chair.—H. **Deslandres**: Arrangement of the large telescope at Meudon for the photography of comets. Application to the Halley comet. Details are given of the addition of a finder to the large telescope and its mode of use for keeping the image of the comet on a fixed point of the photographic plate.—H. **Deslandres** and A. **Bernard**: Preliminary note on the spectrum of the Halley comet. At the Lick Observatory W. Wright found this comet to give an absolutely continuous spectrum; the results obtained by the authors, on the contrary, show clear discontinuities in the spectrum. There is a possibility that two condensations noted in the ultra-violet are near the bands λ 388 and λ 391·45 found in the Morehouse comet. Further measurements are required, but it seems proved that the comet shines by its own light, part of which is due to incandescent gases.—H. **Poincaré**: A generalisation of the method of Jacobi.—M. **Coggia**: Observations of comets made at the Observatory of Marseilles with the Eichens 26-cm. equatorial. Data are given for Daniel's comet on December 9 and 10, and Halley's comet on December 2, 3, 4, 5, 8, 9, and 10.—Eugène **Bloch**: The Hertz photoelectric effect. The classification of metals in the order of their photoelectric effect is modified by the wave-length of the light employed.—G. A. **Hemsalech** and C. **de Watteville**: The line spectrum of calcium given by the oxy-acetylene blow-pipe. The spectrum approaches that of the arc in the number and intensity of the lines. The relation between the number of lines and the nature of the flame is discussed.—A. **Lafay**: An arrangement for the determination of very small differences of pressure. A silvered collodion film is displaced by the pressure to be measured and brought back to its original position electrostatically, an interference method being used to measure the displacement.—E. **Caudrelier**: The discharge of inductors. The influence of the primary condenser on the length of the spark.—Louis **Dunoyer**: The variation in the conductivity of glass with temperature.—P. A. **Guye** and N. **Zachariadès**: The reduction of weighings to a vacuum applied to the determination of atomic weights. A revision of the figures given in an earlier paper, in which the errors caused by the presence of occluded air in the salts weighed are determined. This occlusion of air results in the density assumed in the corrections to the weight in a vacuum being taken too low.—L. **Bruninghaus**: A relation between absorption and phosphorescence.—J. **Taffanel**: Experiments relating to the propagation of coal-dust explosions in mine workings. The inflammation of the coal-dust was started in these experiments either by exploding a small charge of dynamite or some cubic metres of a mixture of methane and air. Measurements of the velocity of propagation of the wave at varying distances from the firing point were made, and the effect of obstructions and changes in the direction of the gallery studied.—E. **Goutal**: The estimation of carbon monoxide in steel. In a previous paper the author has shown that during the solution of iron or steel in cupric chloride a small amount of carbon monoxide is given off, corresponding to about 0·006 per cent. of the carbon in the steel. The first experiments were carried out with iodine pentoxide as the oxidising agent; it is now shown that identical results are obtained when blood is used as the reagent. An amount of carbon monoxide of 0·0142 per cent. by weight represents the limit of saturation for solid steel.—Emm. **Pozzi-Escot**: The separation of vanadium, molybdenum, chromium, and nickel in special steels.—G. **Chesneau**: The analysis of niobites and tantalites. The proposed process is described in detail, and as an example of its application the complete analysis of a tantalite is given.—P. **Freundler**: Some *c*-oxyindazylic derivatives.—Marcel **Godchot**: Some derivatives of dicyclohexylphenylmethane.—M. **Chevalier**: The scientific expedition to eastern Africa, September and October, 1909.—L. **Trabut**: Some facts relating to the hybridation of Citrus and on the origin of *Citrus aurantium*.—E. **Coquidé**: The plurality of the types of vegetation in the peaty soils of the north of France.—A. **Prunet**: The resistance of the Japanese chestnut to disease (*maladie de l'encre*). The chestnut has been destroyed in various parts by a cryptogamic disease of the roots, and experiments have been made during the last six years on the possibility of replacing the French trees by an American or Japanese variety. The American tree did not resist the disease, but so far the Japanese tree appears to be immune. The latter grows well, and its introduction may have important economic consequences.—Paul **Becquerel**: The variations of *Zinnia elegans* under the action of traumatisms.—Émile **Gautrelet**: The partial transformation of fatty food materials by pepsic and pancreatic digestion *in vitro*. It is shown that mannites are the result of this partial digestion.—H. **Guillemard**, R. **Moog**, and G. **Regnier**: The dehydration of the organism by the pulmonary and cutaneous channels and its variation with altitude.—Maurice **Holderer**: The influence of the reaction of the medium on the filtration of the diastases. Sucrase from *Aspergillus niger* was chosen as the diastase for these experiments. In media neutral to phenolphthalein, this sucrase passes entirely through porcelain filters; in media neutral to methyl orange, the sucrase is completely retained by the filter.—R. **Anthony**: The elevation of *Zeugopterus punctatus* at the maritime laboratory of Saint-Vaast-la-Hougue.—L. **de Launay**: The characteristic features of hydrothermal springs.—Paul **Lemoine**: The magnitude of the shrinking produced by the folds of the Paris basin.—G. **Delépine**: The succession of fauna and the distribution of the facies of the Carboniferous limestone of Belgium.—René **Gambier** and Armand **Renier**: Observations on Pinakodendron.—E. A. **Martel**: The subterranean hydrology of the *massif* of Penè-Blanque or Arbas, Haute-Garonne.—Charles **Moureu** and A. **Lepape**: The gases from thermal springs: the presence of krypton and xenon. The gases from twenty-six springs were freed from gases other than the rare gases in the usual way. The residual rare gases were fractionated, firstly, by wood charcoal at the temperature of liquid air, thus separating the helium and neon, and the remainder further treated with charcoal at −23° C. The xenon and krypton were then obtained from the charcoal. These two gases were identified in every one of the waters examined. Blank experiments were also carried out to guard against the possibility of a leakage of air into the apparatus during the analyses, with negative results.

CALCUTTA.

Asiatic Society of Bengal, December 1.—W. A. **Inglis**: Rivers of Bengal. The author refers to Captain Hirst's article on the Kosi River, and discusses the general question of the construction of marginal embankments, which have for their object the prevention of the overflow of floods.—D. **Hooper**: The secretion of *Phromnia marginella*. In north-east India the larvæ of these insects secrete in the dry weather a saccharine substance, which gives to the plants they affect a snow-white appearance. The chief constituent of this deposit is dulcitol (dulcite). The Phromnias are frequently found upon Celastrus, Elæodenoton, and other species of Celastrinea, and it is interesting to know that chemists have isolated dulcitol from several plants of this natural order.—Hem Chandra **Das-Gupta**: A probable identity between *Clypeaster complanatus*, Duncan and Sladen, and *Clypeaster Duncanensis*, Noetling. The author gives reasons for thinking that *Clypeaster Duncanensis*, Noetl., was founded on large specimens of *Clypeaster complanatus*, Duncan and Sladen.

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THURSDAY, DECEMBER 30, 1909.

BLOOD-SUCKING FLIES.

Illustrations of African Blood-sucking Flies, other than Mosquitoes and Tsetse-flies. By E. E. Austen. With coloured figures by Grace Edwards. Pp. xv + 221; 13 plates; 3 text-figures. (London: British Museum, Natural History, 1909.) Price *1l. 7s. 6d.*

THE extraordinary progress that has been made of recent years in the study of tropical medicine has had the result of establishing clearly the general truth that most of the diseases peculiar to the tropics, whether of man or animals, are due to the effects of parasites, microscopic or ultra-microscopic, introduced into the system by the agency of blood-sucking invertebrates. The intermediate host in such cases is usually an arthropod, and most frequently a dipterous insect. Not only has this mode of infection been demonstrated beyond all possibility of reasonable doubt, for such formidable scourges as malaria, yellow fever, sleeping sickness, and various diseases caused by trypanosomes in animals, such as nagana and surra, but it is highly probable that many other forms of disease, less thoroughly investigated at present, originate in a similar manner. Moreover, as in many other cases of parasitism throughout the animal kingdom, a particular disease-producing parasite may be transmitted from one vertebrate host to another only by one restricted group, perhaps even by a single species, of the blood-sucking invertebrates concerned, while other forms may be incapable of harbouring the parasite, or, to express the matter more correctly, are capable of digesting the parasite together with the blood, when taken up in the usual course of feeding.

For these reasons the study of the Diptera, or two-winged flies, has assumed an importance which, twenty years ago, could hardly have been foreseen either by the scientific or the practical man, even in the wildest flights of the imagination. At that epoch, which seems very remote when considered from the standpoint of present knowledge, none but professed entomologists, and not many even of them, occupied themselves with a group of insects unattractive or even repulsive when compared with such popular favourites as butterflies or beetles. Now, however, the Diptera and other blood-sucking arthropods are studied eagerly in all parts of the world, and not by specialists alone. The scientific knowledge of these creatures, their habits and life-histories, has become of immense importance from the economic and medical standpoint, and the distinction and recognition of forms harmful or harmless, from the human point of view, is a branch of study which has invaded even the medical curriculum, at least in schools of tropical medicine. The attention of the medical man is not directed solely, however, to blood-sucking insects, since it is becoming generally recognised that the common flies which haunt our houses and crawl over our food are also fruitful sources of disease.

An Englishman may feel legitimate pride in the lead taken by our national museum in this branch of study. Under the auspices of the British Museum of Natural History, and by the initiative and encouragement of its former director, Sir Ray Lankester, a number of works on blood-sucking Diptera have been published, works of the highest value both from the scientific and the practical point of view. The museum is especially fortunate in having the services of the foremost authority on the Diptera, Mr. E. E. Austen, whose monograph on the tsetse-flies is now a classic, and recognised all over the world as the standard work on these insects.

In the present work Mr. Austen excludes the tsetse-flies already dealt with by him, and the mosquitoes, on which a monograph by Theobald is in progress, and deals with other African blood-sucking flies. He aims at giving descriptions, figures, and general information such as will enable, not only experts, but more especially travellers and medical men in Africa to distinguish and identify the various forms already known, and to collect more material for the study of the Diptera, and so fill some of the many gaps in our knowledge of this group. It is not possible to praise the work more highly than by saying that it comes up to the standard of former works by the same author. Written with a view to the requirements of those who are not specialists, the book does not contain cumbrous descriptions in technical language, but relies chiefly on the excellent illustrations. Every species of fly dealt with is figured in colours at a scale of magnification indicated by a line below the figure. The distinctive characters of the families and genera are given in plain language, together with brief accounts of their habits, life-histories, and relations to disease, so far as such facts are known at the present time. The species are not described in detail, but where necessary their distinctive features are pointed out, and their distribution is given, with a list of the localities whence the specimens in the museum have been obtained. Finally, a list of the flies is given, arranged under countries, so that anyone residing in Africa or intending to travel there can see at once what biting flies other than tsetses or mosquitoes are known at present to occur in any particular region.

This book fulfils admirably the purpose for which it is intended, and will certainly be of the utmost value to travellers and residents in Africa. It will also stimulate the collection and study of these insect-plagues, and will thereby contribute more than any other cause to itself becoming out of date. It is to be hoped that supplementary volumes will be published as material accumulates and knowledge increases. If so, the supplements will probably far exceed in bulk the original work, in course of time. The subject-matter of the work could only be criticised by an expert, and is distinguished by erudition and accuracy. The arrangement of the contents is clear and time-saving, with a complete index. The illustrations are admirably executed and reproduced. If we might offer a suggestion, it is that a national achievement of such importance would have its value and usefulness greatly increased if its price were more within the reach of modest means. Doubtless such a book is very expensive to produce, but surely this is a case where the wealthy treasury of a great nation might have balanced a possible pecuniary loss against a certain imperial gain.

E. A. M.

A NEW TEXT-BOOK OF PALÆOZOOLOGY.

Lehrbuch der Paläozoologie. By Prof. E. Stromer von Reichenbach. I., Wirbellose Tiere. Pp. x+342. Naturwissenschaft und Technik in Lehre und Forschung. (Leipzig: B. G. Teubner, 1909.) Price 10 marks.

IN several features the present volume may well claim to be in advance of many of the text-books on the subject which have appeared during latter years. Instead of being a mere systematically arranged and uninteresting descriptive catalogue, it provides splendid material for the student who desires an intelligent understanding of the subject.

In a well-written introduction the author discusses the scope of the science, the history of its origin, the present state of our knowledge of the science, conditions of fossil-preservation, the relationship of palæozoology to other sciences, and, lastly, the constitution of the skeleton in different animals. For the most part the work is limited, except in some of the more thoroughly investigated groups, to the treatment of orders and higher divisions. Greater detail would have defeated the end in view—that of providing a clearly written exposition for beginners who are assumed to have only elementary knowledge of zoology and no acquaintance with geology. The lower animals receive much attention, and their discussion occupies a considerable portion of the volume. An attempt has been made to embody the recent researches in the different sections without unduly obscuring the clearness. Thus, for instance, in the section on the rugose corals is given the explanation of the septal plan as recently set forth by Carruthers.

Other important features are the paragraphs on the geological distribution and the evolution of each group, as well as the concise summary of the diagnostic characters of the several groups at the close of the treatment of each phylum. A general discussion of the contributions of palæozoology to the study of phylogeny is reserved for the second volume. A valuable list of the chief works at the end of each section provides the necessary guide to those students who might wish to continue the subject further.

The use of a special mark to signify extinct forms is unfortunate, since the necessary frequence of these signs in some parts proves to be a distracting eyesore. Moreover, Frech has used the same mark in his "Lethæa Palæozoica" to denote the last appearance of a form in the stratigraphical sequence.

Undoubtedly, one of the outstanding features of the book is the excellence of the illustrations and the introduction of so many that are new in a text-book. The clearness of the figures and the conciseness of the explanatory notes leave nothing to be desired. The inclusion of technical terms such as "latisellat," "kryptodont," and "iterative Formenbildung," in the index must prove very useful.

On the whole, the author can be congratulated upon producing a very good and serviceable text-book, for he has succeeded very well in preserving the educationist's ideal of a treatment proceeding "from the known to the unknown," and not, as is often the case, "to the unknown through the more unknown."

IVOR THOMAS.

CHEMISTRY IN COURT.

A Manual of Forensic Chemistry, dealing especially with Chemical Evidence: its Preparation and Adduction. Based upon a Course of Lectures delivered at University College. By William Jago. Pp. viii+256. (London: Stevens and Haynes, 1909.) Price 5*s.* net.

IN one way or another, chemical matters form no insignificant proportion of the cases dealt with by our police courts and civil tribunals. Poisoning tragedies, infringement of patents, adulteration of food, and even libel actions—these are some, but by no means all, of the causes which serve to bring chemist and lawyer professionally together; and, not infrequently, chemist and lawyer find themselves at loggerheads.

There are legal subtleties which the chemist is apt to overlook. For example, a well-known scientific witness once set out to explain what a certain claim in a specification meant. "Kekewich, J.," interposed with the remark, "That is for me, Sir James." So the witness had to cast about for a more acceptable form of words. "Speaking as a chemist," he said, "the following words in the claim mean to me" so and so. With this preliminary the evidence was admissible, and the witness was allowed to proceed.

On the other hand, there are chemical distinctions which to the lawyer are often a mystery of mysteries. Our author recognises this, and seeks, as far as may be, to make the rough places plain for the members of both professions.

For the lawyer, he explains shortly the objects and principles of chemistry. He gives examples of "direct" and "indirect" methods of analysis, and directs attention to such points as the collection of fair samples, the changes which in perishable articles may affect the analysis, the occurrence of "traces" of a constituent, and the control of results by "blank" experiments. For the chemist, there is very good advice on such matters as the preparation of the "proof," the form of the certificate, and the use of books in the witness-box. For both, there is a collection of illustrative cases, bringing out the chief points and rulings which affect present-day practice. Many of the *causes célèbres* of the last fifty years are quoted. Thus the Palmer and the Maybrick poisoning prosecutions, the cordite litigation, the "what is whiskey?" proceedings, the libel action in connection with altar candles, and the disputed validity of the Badische Anilin Company's patents, are some of the many cases which are made to point a moral for the reader's benefit.

Possibly a little more chemistry would have been welcome to the lawyer. Perhaps, also, the chemist would like to see a fuller discussion of the principles of evidence after the manner adopted on p. 245, where not only the practice but the reasons for it are adduced. Precedents, however, bulk largely in legal work; and if the chemist, from his training and mental leanings, would rather have had more principle and less precedent, it does not follow that he would have found it of more actual utility. Nevertheless, the author might note these suggestions in view of a second edition. In any case, the book can be recommended as a helpful and interesting one to those for whom it is written. C. Simmonds.

THE MORPHIA HABIT.

The Morphia Habit and its Voluntary Renunciation. A Personal Relation of a Suppression after Twenty-five Years' Addiction. By Dr. Oscar Jennings. Pp. x+492. (London: Baillière, Tindall and Cox, 1909.) Price 7*s*. 6*d*. net.

It were well, if time permitted, that each physician should experience in his own person (meaning thereby his whole person, psyche and soma) a few typical examples of the complaints which he will have to treat. He would thus acquire an insight into disease obtainable in no other way, and with Æneas might exclaim:—

> "Quæque ipse miserrima vidi,
> Et quorum pars magna fui."

This apt quotation is found on the title-page of Dr. Jennings's book, and its aptness lies precisely in this, that the book includes, in the shape of a diary, the record, from within, of the overcoming of an addiction to morphia of twenty-five years' standing. Of habit, pernicious, no more typical example could have been selected than the morphia habit, and this treatise presents us with a valuable contribution to the study and solution of a very serious problem.

Dr. Jennings approaches the problem by two paths, the psychologic and the somatic, in this order. His primary demand is that the patient shall bring, on his part, the desire, the intention, the will (what remains of it), to get well; that before all else the psyche point in the right direction. His next demand is that the physician shall, on his part, supply encouragement, and shall instil into the patient, first a full confidence in himself as guide, and then a spirit of self-reliance; or the order may be reversed, it does not matter so long as hope, trust, and self-reliance find an entry. He urges, and it must be clear, that the best of all cures can only be upon these lines, and that cures which have been effected without the patient's willing cooperation, *a fortiori*, against his will, must be inferior in value. To seek a simile, the willing and the unwilling cure may be likened to the cure of an infectious disease, brought about, on the one hand, by the successful resistance of the patient's own tissues, on the other, by the aid of antidotal powers (anti-toxins) which the efforts of alien tissues have supplied. We have reason to believe that the immunity acquired by the former is the more complete and the more lasting.

Dr. Jennings, however, is not content with teaching a reasonable doctrine; he shows further, by his record of successful cases, the feasibility of the plan which he advocates. With much practical wisdom, he will not allow us to forget that the problem has a somatic side; he is too good a physiologist not to see that to deny this is to deny physiology, "the solid ground of nature"; also that to recognise a somatic side, yet to deny the possibility of material access to the body, as by the medicaments, is to deny physiology once again, since pharmacology is but a department of physiology. On this subject, the value of drugs in the treatment of the morphia habit, the author has much of interest to tell; in particular he insists upon "his therapeutic triad," the use, namely, of heart tonics—of alkalies, especially Vichy water—and of hydropathic measures, notably the Turkish bath. His views do not always fit in with pharmacological teaching, *e.g.* in the value which he assigns to sparteine, but here the last word must rest with the clinicist.

Dr. Jennings's dietetic handling of his subject strikes the reviewer as interesting and original, and as mindful of the dietetic wisdom of the Hippocratic aphorisms.

By means dietetic and medicinal, as set forth by the author, the stress of the bodily cravings is eased and the enfeebled will enabled to maintain its operation; maintaining its operation, volition, according to the law of growth, is gradually built up, the habit of right operation becoming ingrained. Thus in the re-education of the will, the great force of custom is called upon to help to overthrow that dominance which the great force of custom had established—"Certa viriliter"; said S. Thomas à Kempis, "consuetudo consuetudine vincitur." The victim of habit may take these words to heart, and in this record of Dr. Jennings find further encouragement to persevere, and along what lines to seek and find health.

SCHOOL GARDENS.

Practical School Gardening. By P. Elford and Samuel Heaton. Pp. 224. (Oxford: Clarendon Press, 1909.) Price 2*s*. net.

Few educational movements of recent years have produced a more copious crop of text-books, hand-books, readers, and so on, than what is called nature-study. This result is not quite in harmony with the spirit of the movement, which is to avoid the book and study the thing. The child is to use his own eyes, to observe the thing itself in its proper habitat, and in relation to its ordinary surroundings; from these observations he is to make deductions, and thus he is to be trained to think. Of course, the scheme has to be modified to suit the exigencies of the time-table, but it has been shown to work and to give country children a living interest in their surroundings, besides providing the teacher with a powerful engine for education. The final success of the method depends, however, on how far the teacher himself possesses the proper habit of mind, and how far he has overcome the dependence on text-books which has been fostered by his training and the habit, born of tradition and the old method of education, of looking a thing up in a book rather than discovering it by observation. One of the consequences of the movement, and one which we hope will prove permanent, has been the establishment of school gardens. Anyone who knows village schools where gardens exist knows the pride that teachers and scholars alike take in them, and their great value from every point of view. A school garden can be made to furnish a vast amount of matter for school lessons, and in addition it instils into the boys that love of gardening so characteristic of the English life of to-day.

The teacher is bound to have text-book help in managing his garden; the proper arrangement of his crops, the times of sowing, the pests or diseases likely to be troublesome, are all matters in which he needs guidance. He cannot afford to make mistakes, his scholars' parents are sometimes expert gardeners, always critical, and ever ready to derive amusement from his little efforts. The book before us will be found very useful in this respect by the teacher, and the instructions for working are quite clear and have been tested with satisfactory results in the school gardens of Oxfordshire. The book is copiously illustrated; indeed, we find a whole page devoted to the photograph of a wheelbarrow and an ordinary watering can. The teacher who intelligently follows the instruction given may quite expect his garden to be successful from a horticultural point of view, and will have little to fear from the carping village critics.

But we do not think this book represents the last word on the subject. Not enough is made of the garden as a means of education, in spite of a highly suggestive chapter by Mr. Meadon on "Discovery Lessons," which shows a full appreciation of the possibilities in this direction. We should like to have seen the book dominated by the spirit of the *experimenter*; instead, we find it dominated by the spirit of the horticultural *instructor,* whose personality comes out on every page, even to the amiable weakness for the long Latin name that we ever associate with the professed horticulturist. It must be admitted, however, that there are difficulties in the way of an experimental school garden. A garden often becomes much too personal an affair to be made the subject of experiment even by the man of science, and how shall the village schoolmaster treat it any more impersonally? The spirit of competition is there; each boy wishes his plot to be the best, and the teacher wishes the garden as a whole to be at least as good as the allotments; experiments, therefore, cannot come in, as he has no room for failures. We are aware, of course, that some schools make trials with artificial manures, but the schemes that we have seen have been entirely empirical, and designed to increase the crop rather than to yield information. We believe that ultimately the school garden will be as successful educationally as it now is horticulturally, and although the present book does little towards helping on this reform it will be found of real value for the school garden as at present conducted. E. J. RUSSELL.

ELECTRIC MOTORS.

The Alternating Current Commutator Motor and the Leakage of Induction Motors. By Dr. Rudolf Goldschmidt. Pp. viii+210. (London: The *Electrician* Printing and Publishing Co., Ltd., 1909.) Price 6*s*. 6*d*. net.

THOSE who are acquainted with Dr. Goldschmidt's writings will open this book with the expectation of finding a very intricate subject treated in clear and simple style, and this expectation will be fully realised. There is no padding, and consequently the reader must not skip, but if he follows the author conscientiously step by step in his close and methodical reasoning he will find his labour amply repaid.

A good deal has been written about the commutator motor, but we have never come across a treatise written so clearly and in such simple language. The simplicity of treatment is not attained by making inadmissible propositions. It is true the author takes us first through the theory of the so-called perfect motor, having no losses and no leakage, but after establishing the main principles which must count in any theory he goes on to introduce step by step those disturbing influences which are inseparable from the practically possible motor, and at every step he finds an easy way of taking account of these influences. The treatment is in the main graphical, and the author's position in the old controversy between the analytical and graphical school is shown by a passage on p. 30, which runs as follows:—

> "The preference for the mathematical or graphical representation is a matter of taste, but I think that many people will agree with me that a very simple diagram, as the present one, will lead more quickly to a clear result, and can more easily be borne in mind, than a more or less complicated formula."

The first part of the book, dealing with the commutator motor, contains six chapters—introductory, the series motor, the repulsion motor, the Latour-Winter-Eichberg motor, some special types, and finally examples of motors, with views and curves of performance, but not many technical data of construction. The only example illustrated by dimensioned working drawings is a 60-h.p. motor made by the Oerlikon Co. The brevity of style is certainly commendable, but in some places it is carried too far. Thus on p. 44, when dealing with the minimum flux required for sparkless commutation, the author gives without proof a formula in which the total flux, that is, the flux per pole multiplied by the number of pairs of poles, is shown to be proportional to the square root of a fraction containing in the nominator the product, horse-power, volts, and length of armature, and in the denominator the product revolutions per minute and diameter of armature. As he says that this formula "will do good service in formulating a general idea of the amount of flux required," we may fairly expect that he should give a proof of it. Another matter in which a somewhat fuller treatment might well be expected is the Deri (not Dery, as the author writes) motor. One page can hardly be considered sufficient to deal with a motor which presents so many interesting features, and is also, from a practical point of view, of immense importance. These are, however, minor blemishes of the author's work; the important thing is that he has given us an eminently useful and readable book on a subject which has too long been neglected in this country.

The second part of the volume under review deals in great detail with the leakage of induction motors and its predetermination. It is a careful investigation of all the different items which influence leakage, power factor, and overload capacity. The subject is highly technical, and will, therefore, mainly interest the designers of induction motors. Specialists in this branch will, however, find the author's method of dealing with the question of leakage, and especially his diagrams and tables, very useful.

GISBERT KAPP.

OUR BOOK SHELF.

Practical Microscopy. An Introduction to Microscopical Methods. By F. Shillington Scales. Second Edition. Pp. xvi+334. (London: Baillière, Tindall and Cox, 1909.) Price 5*s.* net.

ALTHOUGH nominally this is a second edition of Mr. Scales's "Elementary Microscopy," published in 1905, yet it is in effect a new book. The first edition was not so pretentious, and did not attempt to give so much information on widely varying branches of microscopy; in fact, if any criticism may be offered, it is that now too much is attempted.

The actual practical instruction in the use and manipulation of the microscope is particularly lucid, and it is difficult to imagine that it could be expressed more clearly. The theoretical side is practically untouched, perhaps wisely so, as to have gone into the theory with sufficient fulness to have made it intelligible to the ordinary reader would have entailed a great increase in the amount of matter.

The subject of photomicrography has been touched on, and this constitutes an entirely new chapter in the book, as in the first edition no attempt was made to deal with it at all. The instructions given are clear, but are in some respects not so full as an earnest student would desire.

The recently re-introduced methods of dark ground illumination are described, and practical instructions are given in the use of typical illuminators. The various methods of illumination of opaque objects are fully dealt with, both by means of an ordinary condensing lens used in conjunction with low powers and by vertical illuminators for use with high powers.

In general, the book may be commended to any student who requires to use the microscope for ordinary laboratory purposes or for research, as one that will afford him all the practical assistance he is likely to require in the course of his work.

Erosion of the Coast and its Prevention. By F. W. S. Stanton. Pp. 68. (London: St. Bride's Press, Ltd., n.d.) Price 3*s.* net.

THIS book is a reprint of a series of articles which recently appeared in *Public Works.*

It consists of five "parts," or chapters, relating respectively to general observations on coast erosion; the agents of destruction and construction, and their effects on the English coast; land reclamation and coast defence; with an appendix on the Thames estuary. There are several maps showing the coast of England and illustrations of defence works. The maps appear to have been reproduced from larger drawings, the writing and names of places being so diminished and indistinct as scarcely to be legible, even with the aid of a magnifying glass.

The contents of the book form an interesting summary of the condition of coast erosion and protection in England, suitable for a serial publication, but they are of too general and superficial a character to be of any use as a text-book on the subject, and contain no information of consequence that has not been more fully dealt with in books already published. The author does not appear to have made any use of the information contained in the evidence laid before the Coast Erosion Commission, and the fact of this commission being in existence is only once casually mentioned.

The author attributes the destruction of the coast, amongst other agencies, to the action of undercurrents below low water, and of submarine springs and "animal borers," and states that the consideration of such agents of destruction "leads to feelings approaching despair," and "bordering on consternation when the formation of the coast consists of glacial deposit, the London Clay and the like." It would have been more satisfactory if this theory had been supported by instances where this occurs. Although it is also stated that this class of erosion is beyond prevention, in another part of the book a solution of the difficulty is described as being effected by means of submerged chain cable groynes, and it is stated, on the authority of the inventor of this scheme, that these groynes have been laid on flat, sandy shores with excellent results. The locality where this has been done is not given, nor any particulars as to the condition of the shore before and after their use.

The Evolution of the Sciences. By L. Houllevigue. Translated from the French. Pp. 318. (London: T. Fisher Unwin, 1909.) Price 6*s.* 6*d.* net.

IN his preface to the English edition of his book, M. Houllevigue explains that it is not his object to teach men of science anything. "I only wish," he writes, "to interest those who love science as outsiders in the general ideas which form the atmosphere of the laboratory, and, above all, to make them familiar with that superior form of common sense which is called the scientific spirit." Nine subjects are dealt with—the tendencies of chemistry, transmutation and Sir William Ramsay's experiments, the existence of matter, the interior of the earth, the sun, eclipses, the Milky Way, the organisation of matter, and the frontiers of the sciences. Each essay presents the broad aspects of the subject surveyed, and is well calculated to set students thinking about fundamental principles of science. Judging from the absence of reference to work by Joly on radio-activity in relation to the age of the earth, Hale on his solar observations, Kapteyn and Eddington on star-drifts, and other researches of recent years connected with the subjects described, the author has not kept in close touch with all the points in which progress is now being effected.

History of Astronomy. By Prof. G. Forbes, F.R.S. Pp. ix+154; illustrated. (London: Watts and Co., 1909.) Price 1*s.* net.

IN this small volume Prof. Forbes describes the evolution of astronomical knowledge under three periods—the geometrical, the dynamical, and the physical. In addition, in book iii. he also describes the evolution of the instruments which have enabled astronomers of all ages to contribute to the store of knowledge on which our present-day astronomy is based.

The geometrical period covers the ages which elapsed between the time when man simply "wondered" and the time when his collected observations and knowledge had prepared the way for Kepler. This is a very interesting section, in which the methods and ideas of early astronomers are so clearly explained as to demand the attention of the general reader.

As a reference to ancient observations it should also prove valuable.

The dynamical period will appeal more to the student, its main theme being, of course, the establishment of the principles of universal gravitation by the work of Kepler, Newton, Laplace, Halley, and the others. The section on observation gives an abbreviated account of the methods and instruments employed in the more important and epoch-making researches, and contains a deal of interesting matter.

The fourth book, dealing with the physical period, is, perhaps, the least satisfying, but the chief reason for this, probably, is the confined space in which a tremendous amount of matter has to be discussed. As the author states on p. 147, he has been "compelled so often by the limits of space to stimulate without satisfying inquiry," and on these lines the book must be welcomed as a success. Those stimulated will find a useful, brief bibliography, to assist them in their further inquiries, given at the end of the volume.

W. E. R.

Wild Flowers and Trees of Colorado. By Dr. F. Ramaley. Pp. viii + 178. (Boulder, Colorado: A. A. Greenman, 1909.)

THIS book consists of two chapters, in the first of which the author presents a general sketch of the vegetation, and in the second he deals with the forests. Vegetation in the State of Colorado is exceedingly diverse by reason of the varied conditions of climate, and owing to the great variation in altitude the vertical distribution is more pronounced than the horizontal distribution, so that the author groups his associations according to the zones of elevation. There is little information regarding specific wild flowers beyond the illustrations of a dozen selected types and no systematic enumeration is supplied. The book is copiously illustrated with photographs of characteristic scenes or formations and the flowers referred to, making the text shorter than might be anticipated. The survey of the forest formations is more concrete, and twenty of the principal tree or shrubby genera are detailed with respect to the species and their diagnostic characters. The author announces the book as an introduction to Colorado botany, so that he may perhaps be subsequently induced to compile a flora of this interesting region.

(1) *The Historic Thames.* By Hilaire Belloc. Pp. 204. (London: J. M. Dent and Co., 1909.) Price 3*s*. 6*d*. net.

(2) *The Heart of England.* By E. Thomas. Pp. xi + 244. (London: J. M. Dent and Co., 1909.) Price 3*s*. 6*d*. net.

(1) THE first of these prettily-bound volumes is a new, cheaper edition of Mr. Belloc's essay on the Thames, which was issued originally in a limited edition, costing a guinea net. The Thames and its valley is dealt with from every point of view, and the interesting description reveals an intimate knowledge of the subject. The reader's task would have been easier had the book been divided into chapters; the index, notwithstanding its completeness, scarcely takes the place of a judicious division of the essay into sections according to subjects.

(2) The second volume is a similar re-issue of essays on subjects the most diverse. Ranging as they do from "Walking with Good Company" to "The Harvest Moon" or "Fishing Boats," they will make an appeal to readers who can enjoy something other than wild adventure or thrilling incident. Mr. Thomas does not treat his subjects too seriously, and to read his essays will give much the same pleasure as listening to bright, pleasant conversation in which quiet humour takes its proper place.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Are the Senses ever Vicarious?

THE interesting correspondence in NATURE of December 2 from Mr. G. I. Walker and Prof. McKendrick has reminded me of a passage in Nietzsche which will be found at the end of paragraph 192 of "Beyond Good and Evil." The passage has been translated as follows:—

"In an animated conversation I often see the face of the person with whom I am speaking so clearly and sharply defined before me, according to the thought he expresses, or which I believe to be evoked in his mind, that the degree of distinctness far exceeds the strength of my visual faculty—the delicacy of the play of the muscles and of the expression of the eyes must therefore be imagined by me. Probably the person put on quite a different expression or none at all."

Nietzsche's experience appears to suggest that a presentation, which is in form purely visual, may show evidence of a synthesis out of elements which are not solely of visual origin. No doubt, as Nietzsche says, the imagination plays an important part, and the same may be said of the memory; but Mr. Walker's experience seems to prove that in his case some of the elements out of which such a visual presentation are synthesised may be definitely of auditory origin. Perhaps to a psychologist this may not appear very surprising; but it certainly does seem a little surprising that, when the main source of Mr. Walker's visual experiences was cut off by the loss of his sight, the surviving auditory elements should alone be strong enough to continue to evoke presentations in visual form.

That the above is the explanation of Mr. Walker's experiences there seems little doubt. The play of expression which he "sees" will naturally follow the variations in the tone, &c., of the speaker's voice; but it is scarcely so certain that it will reproduce the actual expression of the speaker. As to the circumstance that Mr. Walker only "sees" the upper part of the speaker's face, as a rule, one may hazard the guess that this arises from the fact that in conversation the attention is generally concentrated on that part, with the result that the elements corresponding to it in the visual presentation are the most intense, and hence most likely to survive the destruction of their principal source. Presumably that which Mr. Walker sees is devoid of colour; but it would be interesting to know how the present intensity of his visual presentations compares with their intensity when he originally lost his sight.

Mr. Walker's preference for a position at an angle to the speaker possibly depends on the fact that he thereby secures a more marked difference between the sensations proceeding from the two ears—a difference analogous to the difference between the sensations received from the two eyes.

HUGH BIRRELL.

Holyrood House, Bo'ness, Linlithgowshire, N.B.,
December 8.

THE very interesting observations recorded in Mr. Walker's letter in NATURE of December 2 confirm in a remarkable manner the view I have always held, that in a very literal sense "seeing is believing"; that is, that a visual image is not an image on the retina, but a mental representation of what the percipient believes to be before him. As a rule, no doubt this mental representation is suggested by sense impressions coming *via* one or both optic nerves, but this is not necessarily the case; and it ought to cause Prof. McKendrick no surprise whatever to find Mr. Walker, though blind, perceiving visual images, which in his case are apparently suggested mainly by sense impressions coming through the auditory nerve.

There are, of course, plenty of arguments drawn from everyday life which point to the same conclusion, but which are so commonplace that we take them for granted without attempting to analyse their significance. I will mention one only. From my personal experience I am utterly unable to discover any distinction at the time of perception between a visual image in waking life and one in a vivid dream. It may be that afterwards I recognise that the latter were only baseless visions, but not, as a rule, from any quality or deficiency in the visual percept itself. I am aware that it has been suggested that even in dream images the retina is in some obscure way concerned, but this assumption seems to me quite gratuitous; it is not, so far as I know, supported by any evidence, and ought to be cut off by the razor of Occam.

Edward T. Dixon.

The Hard, Hythe, Southampton, December 5.

The Coloration of Birds' Eggs.

Without wishing to trespass further than I can help upon the space at disposal for discussing this topic, I may just explain that in my reply to Mr. Leslie, June 11, 1908, I distinctly gave it as my opinion that coloration had no connection with Mendelian principles. I concluded that coloration often depended on habitat, and was now useful as a means of protection; but the habitats (and nesting sites) of birds *change*, hence the anomalies met with which are cited as difficulties.

As to the colour-changes of the chameleon, Mr. Leslie ought to remember that this is an act of the animal itself, and a distinctly psychic act, in no way connected with reproduction. The coloration of the bird's egg is primarily the application of a pigment—depending in intensity on health and age—by the bird upon a *product* which has already ceased to form an integral part of the animal before the pigment is applied; and the bird's egg is not—like the mollusc's shell—an organic complement of the animal producing it. One might as well try to trace the evolution of a bird from the track of its foot in the sand as from the coloration of its egg!

So the parallel is inadmissible for this simple reason alone, apart from many others. Moreover, if number, form, size, texture in the shell itself have some morphological significance in relation to the bird's oviduct and secretory sacs, being also determined earlier in the phylogeny (as in the individual's ontogeny) of the group, coloration has little, except upon the selection and store of pigment; and the saurian and early avian eggs, furthermore, were uncoloured.

Thus coloration is a recent acquisition, which, as I have already pointed out, is intimately related—just as eggs and classification are, to some extent—to *habitat*, allied species (even genera or groups) laying allied types of eggs, adopting the same mode of life and nesting site. Thus it is a *physiological* adaptation, and as such cannot explain morphological origins, though as cause and effect we may compare coloration and protection from enemies, &c. In a word, coloration exists for concealment, and markings (*e.g.* the black blotch on the cuckoo's egg) for identification.

A. R. Horwood.

Leicester Corporation Museum, December 20.

THE CAPTURE AND TRAINING OF WILD ANIMALS.[1]

THE name of Carl Hagenbeck has attained such world-wide celebrity that a volume from the pen of the great animal-dealer and animal-tamer must surely receive a hearty welcome from the reading public. The publishers have therefore been well advised in bringing out an English edition of the original German work, although they might have taken care that it bore on the title-page some indication of its being from the pen of Mr. Hagenbeck himself. Whether the title is an exact translation of the German one we are unable to say, but if it be so, a slight modification would have been advisable, as it certainly does not read well in English. Neither, in spite of Dr. Mitchell's testimony as to the accuracy of their rendering, can we congratulate the translators on their style. "The menagerie owner Malforteiner" (p. 226) is not, for instance, elegant English; while a sentence on p. 153 conveys the astounding statement that Mr. Hagenbeck walked off with the fore-leg of a live elephant. On p. 157, as in many other places, we find "which" repeated in the first half of a very short sentence; and on p. 168 we find it stated that "this species is often captured, but in captivity they are very liable to die." On p. 58 the word "lime," in place of "bird-lime," completely spoils a sentence.

Mr. Hagenbeck commences his narrative with an account of his early life, in the course of which he tells his readers how he was initiated into the business of buying and exhibiting animals by his father, who took it up as a kind of supplement to his own proper trade late in life. When he once felt his feet, the author of the present volume forthwith proceeded to organise the trade of wild-beast catching on thoroughly business lines; and as he is the only man that has done so, the consequence is that he has practically monopolised the whole trade. Although it at times undoubtedly yields large profits, and is always full of interest to a man of enterprise and resource, the trade is full of risk, and demands great stability of character and perseverance in the face of losses on the part of those by whom it is conducted. We hear, for instance, of a loss of 10,000*l.* owing to disease seizing a collection of animals at the Crystal Palace for which that sum had been offered; while a sum of 5000*l.* was lost in two unsuccessful expeditions dispatched to Central Asia for the purpose of capturing argali sheep. The sheep were, indeed, captured right enough, but all died on the way home.

Young Walruses at Stellingen. From Hagenbeck's "Beasts and Men."

One of Mr. Hagenbeck's periods of great prosperity took place in the middle 'sixties and up to 1876, when an enormous number of live animals was brought out of the Egyptian Sudan. The menageries of the world were, however, overstocked, and about the year 1877 the author had almost to give away giraffes: this state of affairs induced him to take up the exhibition and training of animals in an establishment of his own—a branch of his business which culminated in the inauguration of the present animal-park at Stellingen. One of his earliest experiments in this direction was the exhibition of a herd of reindeer in charge of a party of Lapps, an exhibition which led to the importation of parties of natives from many other parts of the world.

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[1] "Beasts and Men, being Carl Hagenbeck's Experiences for Half a Century among Wild Animals." An abridged translation by H. S. R. Elliot and A. G. Thacker, with an introduction by P. Chalmers Mitchell. Pp. xiii+299; illustrated. (London: Longmans, Green and Co., 1909.) Price 12*s.* 6*d.* net.

Either personally or by means of his representatives, Mr. Hagenbeck has explored a very large portion of the globe, having brought home, and reared, walruses from Greenland, giraffes, elephants, and rhinoceroses from the heart of Africa, tigers and sambar from the jungles of India, and wild horses and onagers from the fringe of the Gobi desert. The most interesting chapters in the book are undoubtedly those in which the author describes the various methods of capturing wild animals alive, and the behaviour and habits of particular species and groups. Did space permit, we might refer to many stories of adventures and escapes, but we must be content with mentioning one case where a party of some 3000 baboons attacked and beat off the captors of their fellows. These baboons, like many carnivora, are captured as adults by means of traps; but in the case of the larger herbivores Mr. Hagenbeck's most successful method is to train the natives (if they require it) to ride in pursuit of the herds until the young ones are brought to a standstill.

The book, which deserves a fuller notice than can be given here, is rich in interest from beginning to end; and should be of considerable value to all the custodians of zoological gardens. R. L.

THE SEXTO-DECIMAL YEAR OF BRITISH CALENDARS.

In searching English and Welsh calendars for sequences of festivals at intervals corresponding with the sun's stations on quarter and half-quarter days, or, in other words, the quarter days of both the solstitial and the May years—the octave year consisting of eight half-quarters—I find another octave year definitely marked in the calendars, and to a large extent still observed by festivals and fairs. The year of British calendars is definitely sexto-decimal, both the solstitial and May quarter days being duplicated, with the striking result that the eight half-half-quarter days coincide within three days of the exact half-half-quarter stations of the sun, the unit interval being roughly three weeks. The interval between a solstitial and a May quarter day being roughly six weeks, the duplicate octave year may be called an intermediate year.

The intermediate year is evidently the oldest octave of the two. It is the year as observed previously to the publication of the Julian calendar. Its basis was a calendar which was not corrected for the precession of the equinoxes, but which in other respects has been kept up to date. Calendars of other countries present similar anachronisms, but the persistence in Britain of such a belated calendar calls for special notice.

The jumbling together of two festival reckonings, on bases two thousand years apart, has resulted in a strikingly symmetrical sexto-decimal year. The festivals of the older octave were accurately fixed on solar quarter and half-quarter days, a fact which implies either the continued use of astronomical monuments for solar or stellar observation on those days, or a computation based on the exact length of the year. Within the Christian era, the festivals of the older reckoning drifted out of correspondence with the original solar stations. When the dates of the older sequence of festivals were marked in the Julian calendar, it was found—and I think it is hardly possible that the fact could have been overlooked—that the dates were just midway between the solar stations of a Julian sequence of festivals, and it became possible to utilise the half-half-quarter stations of the sun to indicate the incidence of the belated festivals. What makes the subject still more interesting is the discovery by Sir Norman Lockyer and others of indications of similar half-time dates in monument measures (Nature, November 12, 1908, p. 36).

A complete sexto-decimal solar year may be expressed as follows, the nearest round number of minutes of declination being given:—

Sun's decl.		Dates
N. 23° 30′ E.	... ...	June 22
,, 21 30 ,,	... ...	May 29–30, July 16
,, 16 20 ,,	... ...	May 6, August 8
,, 8 30 ,,	... ...	April 12–13, September 1–2
East	... ...	March 21, September 23
S. 8° 30′ E.	... ...	February 27–28, October 15–16
,, 16 20 ,,	... ...	November 8, February 4
,, 21 30 ,,	... ...	November 30, January 13–14
,, 23 30 ,,	... ...	December 23

Half-quarters of the Older Octave.

Date	Dedication	Character of Festival
November 30	Andrew	All Hallows
January 13...	Hilary	Winter solstice
February 28	Oswald	Candlemas
March 1 ...	David	
April 15 ...	Oswald	Vernal equinox
June 1... ...	Tekla	May day
July 15 ...	Swithin	Summer solstice
,, 17 ...	Kenelm	
September 1	Giles	Lammas
October 15...	Ulfrann	Autumnal equinox
,, 17...	Etheldreda	
,, 18...	Luke	

When the older octave only was marked in a calendar, such a calendar was doubtless a lunar one, and sometimes the interval between two festivals exactly corresponds with the solar interval only in a lunar reckoning. For instance, January 13–April 13 represents in the Roman lunar calendar the exact interval between the winter solstice and the vernal equinox, both dates being also Ides.

The intermediate year is clearly a May one, the first quarter, November–February, being rounded by the patron saints of Scotland and Wales. There is abundant evidence of St. Andrew's having been observed as New Year's Day. The interval between St. David's Day and St. Andrew's corresponds to the length of the vegetation year pure and simple. I think St. Patrick's Day, March 17, represents, like St. David's, a Candlemas festival, by a lunar calculation like that of the Coligny calendar. That date about the ninth century coincided with the vernal equinox, when it seems to have been given an equinoctial significance in connection with the commemoration of St. Patrick; but the shamrock, like the date, is reminiscent of a Candlemas festival (Nature, July 25, 1907, p. 295).

In one parish in Glamorgan—namely, Llangeinor—the complete sexto-decimal year was, until recently, observed by holding a court every three weeks. The patronal day is October 8, three weeks before All Hallows, but originally an autumnal equinox festival.

There is much evidence to show that the Scandinavian and German invaders of England, on the one hand, and the Welsh-speaking invaders of Wales from the north in post-Roman times, are chiefly responsible for fixing permanently the intermediate year in our calendar. So much is indicated by the list of saints commemorated, but more particularly by the association in Wales of half-half-quarter fairs with traces of northern and Scandinavian settlements

While in Wales generally hiring fairs are held in May and November, in districts like South Pembroke, known to have been occupied by Scandinavians, the hiring fairs are in April and October, and they represent an old equinoctial division of the year.

John Griffith.

MARINE INVESTIGATIONS IN NORWAY.[1]

THE work done by the Norwegians takes a foremost place amongst the fishery and marine investigations which have been carried out in recent years under the general guidance of the International Council, which was established in 1901 to coordinate the researches of the different countries bordering on the North Sea. The present report gives a general review of this work in readable form, without being burdened with any excess of detail, such detail being reserved for special memoirs, some of which are already published.

The introductory account of the plan and organisation of the work is written by Dr. Johan Hjort, the director of the investigations, and sets forth in the clearest way that effective combination of precise and accurate scientific investigation with practical developments of commercial fisheries which has always specially characterised the work of this investigator. Hydrographical investigation, plankton research, the study of the bottom fauna, each has received its due share of care and attention equally with the study of the natural history of fishes and the experiments which have led to the establishment of new fisheries for cod and for deep-sea prawns off the Norwegian coast.

In one important respect Norway has been especially fortunate, that is in having had the use of a research steamer, the *Michael Sars*, designed and built for the particular work of fishery research, an advantage which a parsimonious Government has denied to those who have to carry out similar work in England and Scotland. A detailed description of this vessel and her special equipment is given by Dr. Hjort, and the efficient and seamanlike way in which she must have been used could not have been better brought out than by the illustration showing the arrangement adopted for working two Petersen young-fish trawls and five tow-nets at the same time, and each at a different water-level. Equally striking are the successful results obtained by working a 50-foot otter trawl at depths of from 400 to nearly 700 fathoms.

The section of the review dealing with hydrographical investigations, by Dr. B. Helland-Hansen, summarises the results which have been reached by a study of the salinities, temperatures, and currents of the Norwegian Sea. In the concluding paragraphs of the section attention is directed to a series of striking correlations between the hydrographical conditions prevailing in the Norwegian Sea and various climatic, fishery, and other phenomena, which appear to be affected by these conditions. Evidence is given for thinking that the amount of heat which the Gulf Stream conveys into the Norwegian Sea has a controlling influence on the winter climate of Scandinavia. From the amount of warmth in the water, recorded as early as the month of May, the author considers that it should be possible to tell whether the succeeding winter will be warmer or colder than usual. For the years 1902–6, in which the investigations took place, a low temperature in the Gulf Stream in the southern portion of the Norwegian Sea in May was followed by an early fishing for cod in Lofoten in the next winter, and *vice versa*. Other correlations of a similar character are also described.

In dealing with the plankton investigations, Dr. Damas gives an interesting account of his observations on the distribution of the medusa, *Cyanea capillata*, which is of considerable importance from its intimate association with the fry of the haddock, whiting, and cod. The fry of these fishes shelter themselves under the disc of the jelly-fishes, and are borne along with the latter in their passive wanderings. Shoals of these Cyanea have been traced from the shores of Jutland into the Skagerak, and thence along the coast of Norway to the north, carrying the young fish with them. Another medusa, *Cyanea lamarcki*, which has its home in the temperate Atlantic, occasionally reaches the west coast of Norway, accompanied by the fry of southern gadoid fishes, poor-cod, pout, and pollack.

But in addition to the more indirect, though not therefore less important or less fruitful, ways of approaching fishery problems, represented by the hydrographical and plankton investigations just mentioned, the Norwegians have devoted very considerable attention to the natural history of the fishes themselves. Dr. Damas writes on the distribution of the eggs and young stages of the gadoids, and gives also many results of the greatest significance concerning the age and growth of these fishes. By an examination of the scales it is now possible to determine with considerable certainty the age of each individual fish. Many catches of cod and haddock were examined in detail in this way, and the number of fish belonging to each year-group was ascertained. The important fact has been determined that fishes born in certain years largely preponderate in the catches, and the effect of these favourable breeding years can be traced in the catches year after year. Similar results have been obtained by Knut Dahl in the case of the herring. Thus in a sample of spring herring examined in the spring of 1907 the eight-year-old fish were in remarkable abundance. The same year-class, in the autumn of 1907, was the most numerous of all the thirteen year-classes which composed the large herring of the coast of Helgeland. In the spring of 1908 several thousand spring herring were examined, and the nine-year-old fish were conspicuously abundant. In the autumn of 1908, in a large sample of herring from Kristiansund, it was found that the 9½-year-old fish were more numerous than either the preceding or succeeding year-classes. In samples from the North Sea and Skagerak the data appear to indicate that here, also, the same year-class predominated. It is clear that knowledge of this kind, if regularly and systematically collected, will enable estimates of the yield of the fisheries to be made some years before the fishing actually takes place, a result which cannot but be regarded as a triumph for the scientific method of approaching fishery problems.

Space has only allowed us to touch upon a few of the more striking features of this report. One would imagine that a perusal of it must convince the most sceptical of the value of the new knowledge which is now being rapidly made available as the result of the labours of the International Council for the Study of the Sea. Unfortunately, in this country the continuation of the work still, to some extent, hangs in the balance, but it is to be hoped that our Government, representing as it does by far the largest fishery interest of the countries bordering on the North Sea, will be induced to take a broad view of its responsibilities.

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[1] "Review of Norwegian Fishery and Marine Investigations, 1900–8." Report on Norwegian Fishery and Marine Investigations, vol. ii., 1909, No. 1.

THE SURVEY OF INDIA.[1]

THE report on the operations of the Survey of India for the year 1907–8, in addition to the usual record of map-making of a utilitarian character, contains several features of scientific interest. We have long been accustomed to a high standard of work from this department, and it cannot be other than a subject of congratulation that we should see evidence, not only of the maintenance of its previous level, but also of continuous advance. The most recently completed geodetic triangulation, extending for a distance of 480 miles from the Indus to the peak Koh-i-Malik Siah, the junction point of India, Persia, and Afghanistan, is the most accurate operation of its class ever carried out in any country. Computed by the ordinary methods, the probable error of a single angle is 0″·21, a quantity not much more than half that of the corresponding figure obtained in any triangulation outside India.

This series of triangles carries the geodetic work to a point marking the most westerly limit reached by the principal triangulation of India. At this distance from the centre of the network the errors of the assumed spheroid become noticeable. Thus the astronomical azimuths observed along this line are consistently smaller than the azimuths computed from the triangulation, showing that the computation is taking the points too far to the north, *i.e.* that the curvature of the spheroid used for the reductions is, over this region, appreciably greater than that of the true geoid.

Pendulum operations were carried on during the year with the special object of ascertaining whether the force of gravity would be found in defect in submontane tracts in the south of India to the same degree as in the Himalayan region. In all cases the deficiency was found to be considerably less at these stations than at places of similar altitude in the north. It was also found that for stations on "isolated" hill-masses the degree of compensation of the visible mass is much less than it is on Himalayan stations. From this the general inference is drawn that it is chiefly the subjacent masses that affect the compensation of those visible on the surface.

All this is quite in accordance with the theory, first advanced by Osmond Fisher, that the "roots" of mountain masses are broader and shallower than the mountains themselves. The time is not far distant when it will be possible to draw an approximate section of these roots. It would be interesting to attempt this, in the first instance, by selecting a mountain, of as great a mass as can be found rising abruptly in a flat country, and carrying out a detailed gravimetric survey of the whole area, including the mountain and the flat region, for a considerable distance from it.

The year under review marks an important epoch in the history of the magnetic operations in India in that the preliminary magnetic survey was completed over the whole country with the exception of some frontier regions. Three iso-magnetic charts are published in the report, showing respectively (1) isogonals, and lines of equal secular change of declination; (2) isoclinals; (3) lines of equal horizontal force. During the current year the beginning of the detailed magnetic survey was projected.

Among other points of interest we may note a re-standardisation, with the international metre at Sèvres, of Colonel Everest's old 10-foot standard, indicating that no appreciable change has taken place in the lengths of the Indian standard bars during the last forty years.

Latitude observations were made with the view of eliciting some information as to the cause of the abnormally high deflection of the level found at Chaniana. It was observed that the deflection diminished rapidly in every direction from the apparent centre, and the conclusion is drawn that its magnitude originates "in a purely local cause, situated either at the surface or at a small distance below it."

E. H. H.

NIGERIA AND ITS PLANTS.

THE first part of an account of "The Useful Plants of Nigeria," written by Mr. J. H. Holland, now of Kew, but sometime curator at Calabar, appears as one of the Bulletins of Miscellaneous Information (Additional Series, ix.) recently issued by the Royal Botanic Gardens, Kew. A brief outline of the history of Nigeria is given in the bulletin, followed by a survey of the physical features, climate, peoples, botany, agriculture, and forestry, and finally the first part of the account of the useful plants of Nigeria.

Mr. Holland complains that "all the maps constructed so far have been compiled in England from sketches made at various times by numerous surveyors independently of each other." This must have been written some years ago, as Government surveyors have been at work since 1902, both in Lagos and southern Nigeria, and some very good maps have been compiled and issued both by the Survey and the Intelligence Department since 1906. In this connection southern Nigeria has to be congratulated on the excellent work done by skilled native surveyors who have been trained on the coast by the heads of these departments.

It is only too true that the entrance to most of the rivers is too shallow to admit steamers of any great draught, but it has to be remembered that this difficulty has to a certain extent been met by the remarkable build of Messrs. Elder Dempster's steamers, and so far as Lagos is concerned by the indomitable will of Governor Egerton, who already has two great dredgers at work on the Lagos bar. Much larger steamers are now entering the Lagos lagoon, and the hope is that passengers for Lagos who are now transferred from the ocean-going steamers to branch boats will soon be able to land direct on the marina. When these difficulties are overcome, and the railway, already open as far as Jebba and beyond, reaches the hinterland of northern Nigeria, Europe will have easy access to a climate described by Mr. Holland as bracing and delightful, and a country rich in agricultural and mineral wealth.

Under the heading "Climate," Mr. Holland touches on the remarkable difference between the rainfall on the coast and the interior; "during 1906 the maximum rainfall was 251·49 ins. at Egwanga, and the minimum at Olokemeji 40·92 ins." The latter place is only ninety miles from the coast. The author also mentions the Harmattan, a wind which comes from the north-east, across the Sahara desert, characterised by excessive dryness. This wind is prevalent during the dry season, and it is this break in the seasons and this Harmattan that we fear are going to decrease the yield of latex of the Para (*Hevea brasiliensis*) introduced from Ceylon. The Director of Agriculture for the French Colonies on the West Coast of Africa is said to be satisfied, so far as the coast is concerned, that *Hevea brasiliensis* is not going to be a success. We know that the trees at Aburi, on the Gold Coast, have ceased to yield latex. From experiments, however, in southern Nigeria on trees nearly eight years old, it is expected that the yield per tree will be more than that now given by the native tree (*Funtumia elastica*), but less than that extracted in Ceylon or other places where this break does not occur.

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[1] General Report on the Operations of the Survey of India, administered under the Government of India during 1907-8. Prepared under the direction of Colonel F. B. Longe, R.E. Pp. iv+62, and maps. (Calcutta: Government Printing Office, 1909.) Price 3*s*.

Mr. Holland, under the heading "Botany," touches on the remarkable "increase of our knowledge of the flora of Tropical Africa," which he says "is due to several causes. Old collections

> "of very considerable extent which had only casually and partially been studied have now been worked up systematically (*e.g.*, Barter's West African, Schweinfurth's Sudan, and Welwitsch's Angola collections); fresh collections have poured in as new countries were opened up or the establishment of botanical stations in the older colonies facilitated a more exhaustive exploration of their neighbourhood; finally, it was just then Germany started with remarkable and well-directed energy on the botanical survey of her colonies, with the result that in not a few orders 50 per cent. or more of all the additions from recent collections are due to her enterprise."

Anyone who has resided in Nigeria, and has had other duties to attend to, must have had cause to bemoan his inability to make satisfactory horticultural, museum, or herbarium collections; well, in this book he will find full instructions how to make them, though the reader, while thankful to Mr. Holland, will still wonder why Hooker's country has not had the enterprise to do the same as Germany.

The botanical station at Ebutemeta, formed in 1887, has been reduced very greatly in area owing to the needs of the fast developing Lagos Railway, and as it cannot be extended in any direction, has almost ceased to be a distributing centre. But we may fairly conclude that the department's work has not been in vain from the following advertisement in the *Nigerian Chronicle*, October 22, 1909:—"FLOWERS, FLOWERS, FLOWERS! Apply to ONOFUNMI GARDENS, FAJI MARKET."

Olokemeji has quite taken the place of the gardens at Ebutemeta, and is a very large distributing centre. It has become the headquarters of the Forestry Department in southern Nigeria. Native pupils are being trained as agricultural and forest instructors in this interesting spot, once a great Abeokuta war camp. We note the omission of a plan of the gardens and reserve at Olokemeji, but plans are included of the now famous gardens in Calabar, which the author had so much to do in founding, and also of the plantations at Onitsha. He also gives a very interesting historical account of the founding of these botanical stations, and finally of the origin of forest conservancy in Nigeria.

The first part of this interesting publication closes with an incompleted list of the useful plants of Nigeria, a work long looked for by all those interested in the economic development of this remarkable dependency of Great Britain. Wherever we may happen to open this instructive book and commence reading we are at once interested, for be the subject fruit or seed, fibre or timber, the author has so much to say of their virtues and uses that we are for the moment apt to forget all sordid difficulties and to wonder how it is more fortunes have not been made in Nigeria. For instance, the author, describing the *Lophira alata*, writes:—"The wood is very hard and heavy . . . described in the trade as a first-class heavy fancy wood; used for furniture and turnery (Mus. Kew). Admiralty experts have valued it as better than teak (*Tectona grandis*), at about 8*d*. per foot." Now, knowing that this wood is very abundant in Nigeria, timber merchants there have shipped it home, and instead of the expected 8*d*. have had to receive 2½*d*. or 3*d*. If the Admiralty or any buyer in Europe would guarantee the merchants in Nigeria 5*d*. per foot for this timber the buyer could rely on a constant supply, and the merchants would make their fortunes. It is the varying uncertainty in the price of mahogany that makes the timber trade such a dangerous one for the merchant, and is perhaps one of the causes why the Forest Department has been urged to start plantations of teak, plantations, by the way, which are so far doing extremely well.

The need that Mr. Holland has so ably endeavoured to satisfy is a really great one, and we can only hope that the reception of his book by the public—so keen on the natural products of Nigeria—will be such that he will soon be tempted to give us another edition of "The Useful Plants of Nigeria," as full as possible of illustrations.

EUGENICS, MENDELISM, AND BIOMETRY.[1]

NOW that the public has become familiar with the word eugenics, it is right that an exposition of its meaning by Sir Francis Galton, the founder of the science, should be easily accessible, and this the Eugenics Education Society has wisely provided by the publication of "Essays in Eugenics." The first essay is on "The Improvement of the Human Breed, under Existing Conditions of Law and Sentiment." It was delivered as the second Huxley lecture before the Anthropological Institute on October 29, 1901. Then follow "Eugenics: its Definition, Scope, and Aims," "Restrictions in Marriage," "Studies in National Eugenics," and "Eugenics as a Factor in Religion," read before the Sociological Society in 1904 and onwards. After this comes the Herbert Spencer lecture delivered before the University of Oxford in 1907, on "Probability, the Foundation of Eugenics," and the volume is concluded by an address to a meeting of the Eugenics Education Society in 1908 on "Local Associations for Promoting Eugenics." The volume, of which the titles quoted give an indication of the contents, forms an admirable introduction to the subject. The host of objections which immediately spring to the mind and tongue of ordinary educated people on first receiving the idea of conscious selective breeding in man are here met with easily intelligible arguments and with common sense. It is to this and to the moderation with which the author expounds his thesis that the present wide realisation of its practicability must be due.

The *Mendel Journal*, of which the first number appeared in October, has been founded in order "that Mendelism shall be presented to a wider public by men who believe in its truth, foresee its future, and who recognise their responsibilities in the work they do," also in order "to gather for the science of genetics a harvest rich in facts relating to human pedigrees and the inheritance of normal characters as well as of peculiarities," and finally "to make it a medium by which authoritative advice and direction may be given in the form of answers to questions upon matters of general interest relating to problems of cattle, cereal and plant breeding."

More than one-third of the number is taken up by an address by Mr. G. P. Mudge, entitled "Biological Iconoclasm, Mendelian Inheritance and Human Society," delivered to the Mendel Society and to the Eugenics Education Society in June, 1908.

Like many lecturers on eugenics, Mr. Mudge realised that in order to convince people of the supremely important part played by heredity in determining physical and mental characters in man, it was necessary to free their minds from common error that the predominant determining factor is environment. His method of attempting to do this is vigorous assertion, unsupported by any direct evidence. That improved bodily conditions and suitable education can effect a great improvement in even the least promising human material is a belief widely and probably correctly held; yet Mr. Mudge tries to shake it by arguments such as the following:—"From the fertilised ovum of a fish there is developed a fish, not a bird. Transference of the bird to water, or the fish to the skies, will not convert the one to the other." He complains of others "setting up a dogma that rushes in where biological philosophy fears to tread," but his own biological philosophy is none too diffident, and indeed bears a striking resemblance to dogma. His failure to produce direct evidence as to the relative effects of heredity and environment in man is no doubt due to the fact that very little evidence is available, but this should be frankly acknowledged.

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[1] (1) "Essays in Eugenics." By Sir Francis Galton, F.R.S. Pp. vi+109. (London: The Eugenics Education Society, 1909.)

(2) *The Mendel Journal*, No. 1, October, 1909. Pp. 216. (London and Manchester: Published for the Mendel Society by Taylor, Garnett, Evans, and Co.) Price 2*s*. 6*d*. net.

(3) *Biometrika*, vol. vii., parts i. and ii., July and October, 1909. Pp. 236. (Cambridge: University Press.) Price 20*s*. net.

Mr. Mudge then goes on to describe very fully and clearly a simple case of Mendelian inheritance in rabbits, and mentions certain phenomena of inheritance in man which are explicable on a Mendelian hypothesis. He concludes with what is in effect a plea for eugenics, which for him seems to follow as a corollary to Mendelism. To us it appears that he would be more likely to win proselytes if he had rested his case on the broader basis of the generally admitted facts of human inheritance. For although in certain cases these may bear a Mendelian interpretation, it cannot be argued that Mendel's laws have been demonstrated at all widely for man; and it is certain that they have not been demonstrated for any of the characters which constitute civic worth.

Two other papers read to the Mendel Society are included in the journal, namely, J. T. Cunningham, "The Evolution of Man," and C. C. Hurst, "Mendelism and Sex." Original research is represented by "Parthenogenesis in Nicotiana," by Mrs. R. Haig Thomas. Among other contributions from G. P. Mudge are three family histories described in careful detail. These are the first of "Mendelian Collection of Human Pedigrees," which appears as a sort of rival to the "Treasury of Human Inheritance," issued by the Galton Research Laboratory in National Eugenics.

Under the heading "Methods and Results" are included three papers by "Ardent Mendelian"; of these the first calls for special comment. It purports to deal with the "present position of Mendelians and Biometricians." Its meaning looms a little vaguely from a cloud of martial imagery, in which biometricians are represented as an army unsuccessfully resisting the encroachments of Mendelians. The author appears to us completely to misunderstand the position of biometricians, which is simply this, namely, that statistical methods may be applied with advantage to the study of many biological problems, including that of heredity; they do not hold that these methods should be applied to the exclusion of others, such as the Mendelian; and the validity of the statistical descriptions obtained by the correct application of their methods would be in no way impaired, even if Mendel's laws were proved to be universally true. We regret to note that the tone of this article is calculated to be offensive to biometricians; as an instance the following sentence may be taken:—"We may further infer, therefore, that the discipline of the army is very severe, and perhaps this may throw some light upon the constant reappearance of the figure 0·5 in relation to the size of some of its artillery equipment." Since 0·5 is the value obtained very frequently as a fraternal correlation coefficient, it must be assumed that "Ardent Mendelian" means that this agreement is, to put it crudely, the result of "faking." If serious charges of this kind are to be made, they should be made in plain English, and supported by strong evidence. We do not know whether the *Mendel Journal* has an editor; if it has, we venture to suggest to him that it will not lose in dignity or influence by adopting a more courteous tone. It starts with a clean sheet, and need not perpetuate the bitterness engendered by old controversies.

We regret that space does not permit us to deal with the many interesting papers published in this double number of *Biometrika*, but will make reference to two only selected from them. Dr. Galloway gives an account of his seventeen years' experience of canary breeding, with a partial analysis of the results. His conclusions, valuable in themselves, together with the clear descriptions and figures which he gives of the different points of the various breeds of canaries, should be of the utmost assistance to anyone proposing to breed these birds, either as a fancier or for the purpose of studying the problems of heredity.

Dr. Jenkinson deals with the relation between the symmetry of the egg, the symmetry of segmentation, and the symmetry of the embryo in the frog; he finds that "the position of the symmetry plane of the egg is determined, in the absence of external factors, by the path of entrance of the spermatozoon, and the point of the entrance is nearly always opposite to the grey crescent. The position of the first furrow is determined by the second part of the sperm path, the line of union of the male and female pronuclei. Thus the internal factors which determine differentiation and the direction of cell-division are not the same, although they may coincide (when the two parts of the path lie in the same meridional plane). They are also influenced differently by different external factors." It appears that there is always a closer relation between the plane of symmetry of the unsegmented egg and the sagittal plane of the embryo than between the first furrow and either of them.

E. H. J. S.

DR. SHELFORD BIDWELL, F.R.S.

SHELFORD BIDWELL was a distinguished member of that class of men to whom English science owes so much, the amateur, who, holding no post as a professional scientific man or teacher, by voluntary devotion enriches science with investigations of permanent value.

Born at Thetford in 1848, and trained at Caius College, Cambridge, he was placed among the Junior Optimes in the Mathematical Tripos of 1870, and in the following year he obtained second-class honours in the Law and History Tripos. He read for the profession of law at Lincoln's Inn and was called to the bar in 1874. While he was practising as a barrister he cultivated his taste for physical science, and was attracted to the meetings of the then newly founded Physical Society, which he joined in the spring of 1877. Years afterwards, in his presidential address of 1898 to that society, he referred to the matter in the following terms:—

"One of the most useful functions of these institutions (the Physical and other kindred societies) is to bring together and promote friendly intercourse among fellow-workers in a particular branch of science. In this connection, I myself (if you will pardon me for referring to personal matters) owe a heavy debt of gratitude to the Physical Society. At the time when I was desirous of becoming a member, I was not personally known to a single man who was in a position to support my candidature. After some preliminary correspondence, I introduced myself to

Prof. Roberts-Austen, then one of the secretaries; he kindly gave me an introduction to Prof. Adams, the president, and the two were good enough to sign my recommendation form. Who furnished the third signature I never ascertained. In spite of this somewhat inauspicious *début*, it was my good fortune after, and solely as the result of, a few years' more or less regular attendance at the meetings to have made a large number of acquaintances, and, I may say, very good friends, among the leaders and workers in science. I have long regarded my connection with the Physical Society as the source of one of the chief interests of my life; and for the highly valued honour you have done me in electing me to be your president, I cannot sufficiently express my thanks."

Bidwell's first communication to the Physical Society was read on March 13, 1880; it was entitled "On the Influence of Friction upon the Generation of a Voltaic Current," and was a simple investigation into the causes of the operation of the Edison "motograph" or chalk-cylinder telephone receiver. He considered his experiments to show conclusively that the explanation of the changes of friction in that instrument is the electrolytic liberation of a film of hydrogen gas. For the next three or four years he was chiefly occupied which the photo-electric properties of selenium. He invented a method of telegraphic photography based on the use of selenium. In the course of his work he did much to clear up the obscurities and contradictions which until then had hung over the behaviour of selenium. Being himself an excellent mechanic, and having equipped for himself a workshop in his house, he constructed, with his own hands, many simple and beautiful experimental appliances. His method of constructing selenium cells with copper wires wound upon a slip of slate or of mica brought selenium cells within the reach of all experimenters. He investigated the effects of temperature and of moisture upon selenium cells. He also investigated the kindred properties of cells made with mixtures of sulphur and carbon. The next subject to claim his attention was the alleged change in the resistance of carbon under pressure, which led him to a careful investigation of the whole question of microphonic contacts. In an article communicated to the Royal Society, he considered the methods of measuring the electrical resistance of contacts, and found that though the moment before the measurement is made the resistance may be sensibly infinite, the very act of measurement reduces it to a few hundred ohms. Here he touched the question of the coherer, which was destined in a short space to become, in the hands of Branly and of Sir Oliver Lodge, so vastly important for the study of radio-telegraphy.

Bidwell was always a most conscientious worker, never satisfied to publish until he had convinced himself of the reality of his results, and of their originality. He took endless pains to discover what might have been previously published on any subject at which he was working. He had a curious distrust of himself while at work, coupled with a singular confidence in the results when they were once established. He had a profound dissatisfaction with half-knowledge, but yet those subjects as to which knowledge was in an imperfect stage possessed for him a singular fascination. Most of his work consisted in unravelling paradoxical facts or obscure phenomena. Thus he investigated the magnetic expansion of iron, and cleared away the obscurity involved in the case of straight rods by the action of their poles, by showing that an iron ring (which possesses no poles) also expands on being magnetised. In connection with this subject, he re-examined the law of magnetic traction. He was the discoverer, too, of the paradoxical fact that an iron electromagnet, if its core is made of an iron tube with short plugs fitting loosely into its ends, when it is magnetised grows longer by pushing the plugs out, instead of attracting them in. Later, and by a beautifully refined piece of home-made apparatus, he showed that the impact of light is able to affect directly the magnetic state of a carefully demagnetised soft iron rod.

His attention was then directed to the subjective phenomena of vision, and he made innumerable experiments on the "ghosts" that are seen following in the train of a luminous body moving across a dark field. He produced some very extraordinary and paradoxical illustrations of colour-vision by intermittent illumination and vision of coloured objects, which he caused to appear of tints complementary to their actual pigments. The result of these investigations he embodied in a most interesting book, written in a popular style, but essentially scientific throughout, called "Curiosities of Light and Sight," published in 1899. He lectured more than once on these matters at the Royal Institution. Unhappily, in his experiments his eyesight became seriously impaired, and he was threatened with blindness. Fortunately, however, after many months he recovered, and was able to read without pain. In 1900, Bidwell received from his own University of Cambridge the degree of D.Sc. He had been elected a Fellow of the Royal Society in May, 1886; and he served on the council of that society from 1904 to 1906. His presidency of the Physical Society in 1897-9 has already been alluded to. Amongst his later work was the writing of the article on magnetism for the new volumes of the "Encyclopædia Britannica." In consequence of troubles arising from an affection of the heart, Shelford Bidwell had not been able to attend any scientific meetings for more than eighteen months, his last visit to the Royal Society being in May, 1908. He died on December 18 at his residence, "Beechmead," Oaklands Chase, Weybridge, at the age of sixty-one.

DR. R. BOWDLER SHARPE.

IT is with great regret that we have to record the death of Dr. Richard Bowdler Sharpe, at his residence in Chiswick, on December 25. Although Dr. Sharpe had been in indifferent health for some considerable time, he was on duty at the Natural History Museum at least as late as December 14, so that the fatal attack was of comparatively short duration.

Born in November, 1847, and therefore just over sixty-two years of age at the time of his death, Dr. Sharpe was the son of T. B. Sharpe, a publisher, of Cookham and Malvern Link. Educated at Brighton and at Peterborough and Loughborough grammar schools, he entered the service of Messrs. W. H. Smith and Son at the early age of sixteen, and after remaining two years with that firm, migrated in 1865 to the establishment of Mr. Quaritch. Two years later he was appointed to the newly-founded librarianship of the Zoological Society of London, a position which brought him into contact with Dr. P. L. Sclater, and thus no doubt tended to foster that taste for ornithology with which he had been imbued from very early years. Be this as it may, by 1872 Dr. Sharpe had become an accomplished ornithologist, and he was appointed in that year to a senior assistantship in the zoological department of the British Museum, a position from which he was promoted to an assistant-keepership in the vertebrate section in 1895, this latter post being held by him at the time of his death.

Dr. Sharpe was a Fellow of the Linnean and Zoological Societies, an LL.D. of Aberdeen University, and holder of the Emperor of Austria's gold medal for distinction in science; in 1905 he was president of the fourth Ornithological Congress, which met in London.

In addition to being joint author of the earlier portion of the "Birds of Europe" and sole author of various bird-monographs such as those of the kingfishers and birds-of-paradise, Dr. Sharpe compiled 13 out of the 27 volumes of the invaluable British Museum "Catalogue of Birds," and was responsible for the whole of the 5 volumes of the companion work, the "Hand-list of Birds," of which the last volume was completed only a short time before his death. As regards his knowledge of the external features of birds, and his capacity for identifying species, Dr. Sharpe was, if not unrivalled, at all events unsurpassed; and his preeminence in these respects received world-wide recognition. Unfortunately, he knew little of the anatomy of birds, so that in his address on "Attempts to Classify Birds," read before the second Ornithological Congress at Budapest, in 1891, he had to depend for this portion of his subject on information borrowed from Seebohm, who had in turn been mainly dependent upon Kitchen Parker. Under Dr. Sharpe's supervision, the collection of bird-skins in the British Museum increased by leaps and bounds, and has now attained vast dimensions, while it is specially valuable on account of the number of "types" it contains.

As a relaxation from his ornithological studies, Dr. Sharpe devoted, during the later years of his life, a considerable amount of time to the natural history and antiquities of Selborne, where he owned a cottage in which he spent much of his holidays. As the result of these leisure-time studies, he brought out a beautifully illustrated edition of "White's Selborne" in two thick volumes.

THE NATURAL HISTORY MUSEUM.

THE *Times* of December 28 includes further correspondence upon the question of the separation of the Natural History Museum from the British Museum. In the two letters subjoined, Prof. A. Sedgwick and Sir Ray Lankester reply to the letter of Sir Archibald Geikie, published in that journal on December 13, and reprinted in NATURE of December 16.

I much regret that it should be necessary for me to address you again on the subject of the Natural History Museum, but the publication of the correspondence between Mr. Lowther and Sir Archibald Geikie in your issue of December 13 last leaves me no alternative. The only satisfactory thing about the correspondence is the admission by Mr. Lowther that the Trustees are uneasy in their own minds as to the satisfactoriness of the present arrangements. They "are anxious to be reassured," Mr. Lowther writes, "that the management of the Natural History Museum is adequate." This is a sign of grace, if only a small one, but such as it is we are thankful to have obtained it.

Before proceeding to deal with Sir Archibald Geikie's letter, there are two small points to which I desire to call the attention of your readers. The first of these concerns the views of the Trustees as to the proper person to call in for judgment in a matter directly concerning the administration of the Museum. They call in one of their own body. This seems to me to constitute a new departure in judicial procedure. The second is the fact that the President of the Royal Society, in his capacity as Trustee, has allowed himself to be nominated public censor of those of his colleagues who in the last forty years have expressed objections to the system which is under discussion. I also desire to emphasise the following points:—(1) In this prolonged agitation it has always been the system of administration, and not the persons administering the system, which has been impugned. (2) The living protagonists of the agitation hold that a system of control by Trustees is the best, provided that their number is small and that the scientific element, whether professional or other, is not represented as such (see NATURE, April 29, 1909, p. 254).

I now proceed to the consideration of Sir Archibald's letter. It is painful to me to have to call in question the deliberate statement of a much respected friend, and one who holds the high and honoured position of President of the Royal Society. It is hard to be certain of one's motives, but I believe that my sole motive in the present case is that of the interests of science. I also wish to say that I have the same belief as to the reasons which have induced Sir A. Geikie to write his remarkable letter. The issue between us, therefore, is simply one of fact, and can only be decided by an inquiry. I had hoped, especially after Mr. Montagu's letter to you of November 19, that the Trustees might be willing to set their own house in order, and that an inquiry might be avoided. I have not always held this view, and for two years, acting in conjunction with my colleagues, I pressed for an inquiry; but I came to see that there were many difficulties in the way of an inquiry and objections to the possible legislation which might result therefrom, and that the essential points in which we deemed the museum administration defective might be remedied by the action of the Trustees themselves. I therefore welcomed the suggestion in Mr. Montagu's letter, and wrote to you to say so. But so long as Sir Archibald's statements are accepted as authoritative, and so long as the Trustees think along the lines of Mr. Lowther's letter, it is clear that reform from within is impossible, and that an inquiry by impartial outsiders is a necessity.

As Sir Archibald Geikie says that he has made a "careful investigation of the facts of the case," we may presume that all his statements, particularly those which can be tested without any inquiry, will be accurate. Let us submit his letter to that test. His first statement is that the "agitation has been carried on fitfully but persistently in the public Press for many years, and has been supported by *some* well-known men of science" (the italics are mine). That Sir Archibald should have made this statement shows that his investigation has been, to say the least of it, superficial. The recent (during the last half-century) history of the agitation is as follows. In the year 1866 there was a memorial to the Chancellor of the Exchequer, signed by all the most famous biologists of the time (I will enumerate them when I deal with the word *some*), stating that they were "of opinion that it is of fundamental importance to the progress of Natural Sciences in this country that the administration of the national Natural History Collections should be separated from that of the Library and Art Collections, and placed under one officer, who should be immediately responsible to one of the Queen's Ministers." In the year 1874 the Royal Commission on Scientific Instruction and the Advancement of Science, having fully considered the state of the Natural History Departments in the British Museum and taken evidence thereon from the principal scientific authorities of the country, came to the same conclusion. In 1879 the Council of the British Association for the Advancement of Science prepared a memorial to the Prime Minister pointing out that the views of scientific men on this subject, as embodied in the recommendations of the Royal Commissioners, had been entirely overlooked, and that "the question of the administration of the Natural History Collections is one of the utmost importance as regards the future progress of Natural History in this country," and urging upon the Government to take the opportunity afforded by the removal to South Kensington "of effecting the alterations in the mode of administration of the Collections recommended by the Royal Commission." Now ensued a lull in the agitation for twenty years. The cause of this lull is highly instructive, and must be mentioned here. Hitherto the head of the Natural History Collections had been entitled Superintendent, and had been subordinate to the Principal Librarian. In 1885, on the recommendation of the Principal Librarian, Sir E. Bond, the office of Superintendent was replaced by a new office, that of Director, with new duties, new responsibilities, and new salary. The Director was made entirely independent of the Principal Librarian, except in financial matters. Financial independence was offered him, but declined. This meant that the Trustees had accepted the recommendations of the Duke of Devonshire's Commission so far as concerned the independence of the Museum. In 1898, on Sir W. Flower's retirement, it became known that the Trustees had in contemplation the revocation of the position of comparative independence assigned in 1885 to the Director of the Natural History Museum. Accordingly, a memorial was presented to the Trustees stating that, in the opinion of the memorialists, it was "of great importance to the welfare of Natural History that the principal officer in charge of the national collections relating to the subject should not be subordinate in authority to any other officer of the Museum." This memorial was published in the *Times* on July 9, 1898, and on the following day a letter appeared from the Principal Librarian stating that the petitioners had been misinformed, and that no change in the status of the Director was in contemplation. In spite of that public statement the fears of the memorialists were realised, for either in July or August of that year the position of comparative independence assigned to the Director of the Natural History Museum in 1885 was revoked, and the new Director who was appointed shortly after found himself—quite unexpectedly in view of the letter just referred to—in a position very different from that of his predecessor. In September, 1907, a memorial praying that advantage might be taken of the approaching vacancy in the Directorship to hold an inquiry into the administration of the Museum was sent to the Prime Minister, who in July, 1908, received a deputation on the same subject. As nothing resulted from this last effort, a letter was addressed to the *Times* on April 19 of this year calling the attention of the public to the matter. So much for the suggestion that the agitation on this matter has been a Press agitation.

I must now pass to consider the suggestion contained in the words "supported by *some* well-known men of science." The memorial of 1866 was signed by G. Bentham, W. B. Carpenter, W. S. Dallas, Charles Darwin, F. D. Godman, Joseph Hooker, T. H. Huxley, John Kirk, Lord Lilford, A. Newton, W. K. Porter, O. Salvin, P. L. Sclater, S. J. A. Salter, H. B. Tristram, A. R. Wallace and others. The Report of the Royal Commission was signed by the Duke of Devonshire, Sir J. Lubbock, Sir J. P. Kay-Shuttleworth, Dr. Sharpey, T. H. Huxley, G. G. Stokes, Prof. Henry Smith, Mr. B. Samuelson, Sir Norman Lockyer being Secretary. The memorial of the Council of the British Association was signed by W. Spottiswoode, Douglas Galton, P. L. Sclater, on behalf of the Council. The memorial to the Trustees in 1898 was signed by Lord Kelvin, G. G. Stokes, M. Foster, A. Rücker, John Murray, Francis Galton, Henry Thompson, W. Turner, Benjamin Baker, A. R. Wallace, W. F. R. Weldon, amongst others—I have not access to a complete list. The memorial of 1907 was signed by all the Professors of Zoology in the United Kingdom except two, and was supported by all of them. The deputation to the Prime Minister of 1908 consisted of some of these Professors, supported by Mr. Francis Darwin and Dr. Marr. From these lists it is clear that, although it would not be correct to say that this long-continued agitation has received the support of all well-known men of science, yet it would have been nearer the truth if Sir Archibald Geikie had used the word *most* instead of *some* in referring to the support it has received, for the cream of certainly two, and perhaps three, generations of English men of science have taken part in the agitation. Having thus shown that Sir A. Geikie has been inaccurate, not to say loose, in two of his statements of fact, what weight can be attached to any opinion that he formulates in his letter on the subject under discussion? He says that the result of his inquiry has been to convince him "that the agitation has no substantial justification, but has arisen from misapprehension and ignorance," and he goes on to reprove those who have taken part in it in these words:—"If the actual state of the matter had been realised no agitation ought ever to have been started." This is Sir Archibald Geikie's opinion. Let us try to realise for a moment what an extraordinary state of mind it reveals! What a contempt for his colleagues, some of them among the greatest naturalists of the world's history, not to mention great names in other branches of science, some of whom had made a special and prolonged inquiry as members of a Royal Commission specially deputed to deal with this matter, and were masters of administrative methods! His contempt for the knowledge and judgment of his most distinguished scientific contemporaries is so colossal that it almost touches the infinite. But I need not labour this point, nor need I refer to his estimate of the knowledge of those of his zoological colleagues now living, all of whom by their avocations have a special interest in the Museum.

We now come to the last and most important point of all. Sir Archibald says that "the allegation so constantly made, that the Director of the Natural History Museum is under much more than merely nominal control of the Director and Principal Librarian at Bloomsbury is without any real foundation." This, of course, is his opinion on the question which has always been at issue. We, that is my colleagues and myself, traverse it absolutely. Can it be supposed that all the distinguished men in the past whom I have mentioned, and all the biologists now living who have paid special attention to the matter, have undergone the labour and expenditure of time and money which this prolonged agitation has involved without convincing themselves of the reality of this basal element in the question? It is true they may be wrong and Sir Archibald right, but what, I ask all unprejudiced men, are the probabilities? It may be said in reply, "Yes, but what are your reasons for holding this view? You must at least state them." A most reasonable request, with which we are only too anxious to comply if the opportunity is given us. Unsupported statements are worth little, and may easily be turned into personal attacks and lead to useless and hurtful recriminations. An inquiry must be held before a proper tribunal which can receive and sift evidence on this question so important to biological science in England.

At the end of his letter Sir Archibald Geikie draws a red herring across the scent by referring to a matter which, however deeply we may feel it, we have always avoided. It is not the question at issue. That question existed long before the recent circumstances to which he refers arose, and will, unless dealt with, continue long after they are forgotten.

Adam Sedgwick.

Imperial College of Science and Technology,
December 20.

I am sure that everyone connected with natural history or with the Royal Society recognises the amiable tactfulness and discretion of our worthy President. These qualities explain the opinion which he has expressed in reply to an inquiry from the Speaker as to the government of the Natural History Museum. They do not, however, give any weight to it. The essential qualification for expressing an opinion of value on this subject is a knowledge of the facts. Of that, I am sorry to be obliged to say, Sir Archibald Geikie is entirely innocent. The Speaker says in his letter that he understands that Sir Archibald Geikie "has recently made special inquiries on this subject." Sir Archibald himself says he has "had occasion to make a careful investigation of the facts of the case."

Sir Archibald, though he has recently become a Trustee of the British Museum, has not become one of the inner circle of the standing committee. No doubt he supposes that he has acquired some knowledge of the "facts of the case." He has been permitted to see the Red Book of Regulations! But he does not duly estimate the secrecy with which the business of the Trustees is conducted by the standing committee. He knows so little of the matter that he is unaware of his own ignorance. There are only three people who really know the facts as to the proceedings of the Trustees of the British Museum in regard to the Natural History Departments during the last twelve years. The Trustees themselves, even those of the inner circle, do not understand what has been done in their name. Sir Archibald Geikie has not sought information from any one of the three persons who could (were they willing) give it. The individual who really knows every detail as to the actual government of the Natural History Museum by the Trustees of the British Museum during the last twelve years—whether good or bad in their tendency and result—is the late Director of the Natural History Departments. He is in frequent personal relations with Sir Archibald Geikie, but has never been consulted or questioned in any way whatever by that gentleman during his "careful investigation" of the utility or inutility of the present relations of the Trustees of the British Museum to the Natural History Museum.

I am able to state, categorically, that Sir Archibald's opinion is not based upon a knowledge of the facts, and that he has not (for reasons perhaps known to the Speaker and to himself, but not to me) taken the obvious means of ascertaining the facts—since I am the late Director in question. I have always maintained very friendly relations with Sir Archibald and should have been quite willing to assist him in his inquiry. He has not, however, approached me on the subject, and has not received either from me or from others authorised by me any statement on the matter. It will, I think, be obvious to your readers that no one, not even a member of the committee itself, which varies in consequence of absences, replacements by death, inattention, and incapacity to understand the matters discussed, can have such a knowledge of the acts and tendency of the body in question as the official (in this case the Director of the Natural History Departments) who during many successive years attended every meeting (held once a month) as secretary, prepared their agenda, took the minutes of their proceedings, and conducted their correspondence. He necessarily endeavoured to obtain their support for certain lines of policy, and knows, as he alone can know, what they accepted, what they rejected, and the motives and influences at work in determining their assent and their dissent. He cannot make a full statement of his knowledge on these matters except under very special authority and guarantee of immunity. For this he asks.

E. RAY LANKESTER.

Hôtel Ritz, Paris, December 16.

NOTES.

WE regret to announce the death, at eighty-two years of age, of M. Bouquet de la Grye, member of the Paris Academy of Sciences, and distinguished by his work in astronomy and hydrographic engineering.

THE death is announced, in his seventy-fourth year, of Prof. L. Lortet, honorary dean of the medical faculty in the University of Lyons and director of the Natural History Museum in that city. Prof. Lortet was the author of a number of original works, and also of translations of works by Prof. Tyndall and other British scientific writers.

THE juvenile lectures at the Royal Society of Arts will be delivered by Prof. Harold B. Dixon, F.R.S., on January 5 and 12, his subject being the chemistry of flame. The subject is one that lends itself to experiments, and the nature of flame, the properties of oxygen, the nature of various combinations of air and gas, will all be fully illustrated and explained.

THE Paris correspondent of the *Times* announces the death of Dr. L. Malassez, assistant director of the École des Hautes Études, and president of the French Biological Society, in his sixty-eighth year. Dr. Malassez was distinguished by his numerous works on normal and pathological histology and his research work on questions relating to blood tuberculosis and the genesis and nature of tumours.

BY the assassination, on December 22, of Mr. A. M. T. Jackson, Collector of Násik, the Bombay Civil Service has lost one of its most learned members. Educated at Winchester and Brasenose College, Oxford, where he gained the Boden Sanskrit scholarship, he commenced his Indian service in 1888. He was the contributor of many papers on subjects connected with the religion, history, and ethnology of western India, and he collaborated with the late Sir James Campbell in the valuable series of volumes constituting the "Bombay Gazetteer." It was mainly owing to his researches published in the *Indian Antiquary*, Journal of the Royal Asiatic Society, and articles in the "Bombay Gazetteer" that the origin of the Rájput tribes from the Scythian and Hun invaders was established. His untimely death removes one of the most eminent scholars in the ranks of the Indian Civil Service.

THE Research Defence Society desires to direct the attention of all Parliamentary candidates to its work. The society was founded in January, 1908, to make generally known the facts as to experiments on animals in this country, and the regulations under which they are conducted; the immense importance of such experiments to the welfare of mankind; and the great saving of human life and health which is already due to them. It is hoped that all candidates for Parliament, who may desire to acquaint themselves with these facts, will communicate with the hon. secretary, Research Defence Society, 70 Harley Street, W.

THE following appointments have been made at the National Physical Laboratory:—Dr. G. W. C. Kaye has been appointed an assistant in the metrology division. Dr. Kaye holds the degree of D.Sc. of London University, the B.A. research degree of Cambridge, and is an associate of the Royal College of Science and an associate member of the Institution of Electrical Engineers. He was formerly demonstrator in physics at the Royal College of Science, and a sub-lector in physics at Trinity College, Cambridge. Mr. Harris Booth has been appointed a junior assistant in the aëronautics division. Mr. Booth took the degree of B.A. at Cambridge, obtaining honours in mathematics and mechanical sciences. Mr. J. H. Hyde has been appointed a junior assistant in the aëronautics division. Mr. Hyde obtained in 1907 a Whitworth exhibition for engineering, and has had five years' experience at the works of the Great Eastern Railway Company.

SIR HENRY TRUEMAN WOOD, the secretary of the society, has edited a "Directory of the Royal Society of Arts," which has been published by Messrs. George Bell and Sons at the price of 2*s*. The pamphlet, which runs to seventy-six pages, contains a short sketch of the society's history, an account of the trust and prize funds which it administers, a history of the examinations which it has carried on for the past fifty years, a description and pictures of its medals, lists of the Albert medallists and of past and present officials, the charter and by-laws, and other general information, including a list of the proceedings of the past session, and a financial statement for the past year. The pamphlet provides abundant evidence of the honourable part taken by the Royal Society of Arts in the improvement and development of the scientific and technical education of the country. The work of the society is, and has been, at once scientific, technical, industrial, commercial, and artistic. For many years—for it must be remembered the society was founded in 1754—it alone filled the place which is now occupied by the numerous modern scientific and technical associations, the Royal Society and the Society of Antiquaries alone being in existence when the society was inaugurated. It was the Society of Arts that first directed public attention to the national need for technical education, and by its efforts aroused the public feeling which led to the appointment of the Royal Commission of 1881. The whole of the society's work has been carried on without Government aid, or, indeed, without any endowment. It is practically dependent entirely upon the annual subscriptions of its members. We welcome the new directory as likely to direct prominent attention to the excellent work the society is doing.

Dr. Francis Ward, who has been very successful in the photography of marine animals, described his methods, and showed the apparatus that he uses, at a recent lecture before the Royal Photographic Society. In a general sense, the apparatus is similar to the usual type of horizontal photomicrographic camera, but it is so hinged that the camera proper, including that portion of the baseboard that carries the microscope, can be raised into a vertical position. The microscope can be easily unclamped and removed, an ordinary photographic lens screwed into the flange of the camera, and the apparatus is then ready for photographing objects in horizontal or vertical tanks, 6 inches or 8 inches square. To facilitate manipulation the camera has an internal mirror and a hood, as in ordinary "reflex" cameras, so that focussing and adjustment may be done on either the horizontal or the vertical focussing screen. It is thus possible to work rapidly, and to adjust the apparatus in a very short time to the photography of specimens natural size or smaller, up to a magnification of about two thousand diameters. These high magnifications are obtained with a high-power projecting eye-piece and the longest camera extension—about 30 inches. For low magnifications, up to about twenty-five diameters, Dr. Ward prefers Zeiss's micro-planar lenses. By the use of a small arc-lamp as made for microscopic illumination, "instantaneous" work is possible, and Dr. Ward showed, by way of illustration, a photograph of living and moving oyster spat, magnified sixty diameters, taken in the tenth of a second. One special advantage of colour photographs, as on autochrome plates, was mentioned, namely, that specimens which will only take a quickly fugitive stain can be photographed while at their best, and so a permanent record obtained.

Alcyonarian and madreporarian corals from the Irish coast are discussed by Miss J. Stephens, of the Dublin Museum, in "Fisheries, Ireland, Sci. Invest., 1907, No. 5 (1909)," the paper including the description by Prof. Hickson of a new species of the genus Stachyodes.

Pictures of Arctic and Antarctic scenery, by Mr. F. W. Stokes, form some of the latest additions to the museums of the Brooklyn Institute. According to the December number of the *Museum News*, Mr. Stokes is absolutely the first to represent the scenery of the Antarctic in painting, while he has had but one predecessor in depicting that of the Arctic.

Among the additions to the Bristol Museum and Art Gallery recorded in the report for the year ending in September last are living specimens of Polypterus and Protopterus collected by the late Mr. J. S. Budgett, which have proved a source of interest to visitors. Numerous misprints of names, such as Myopotomus, *Procyon lator*, and Spizoetus, are apparent in the list of additions.

Naturen for December opens with a memoir and portrait of Mikal Heggelund Foslie, for many years conservator of the botanical collection at Trondhjem, who died on November 9, in the fifty-fourth year of his age. Prof. Foslie, who was well known in this country, devoted special attention to the calcareous algæ, of which he described the collection brought home by the Percy Sladen expedition to the Indian Ocean. In 1892 he paid a visit to the Isle of Wight for the purpose of collecting these organisms, and he also made a trip to Ireland seven years later with the same object.

We have hitherto omitted to mention that in the October number of the *American Naturalist* Miss Dederer comes to the conclusion, from a careful study of the skull and dentition, that the South American marsupials of the genus Cœnolestes appear to be more nearly related to the polyprotodonts than to the diprotodonts, among which they have hitherto been placed. In fact, the large pair of lower incisors, which may well be an adaptive feature, forms practically the only diprotodont character, the dentition in other respects being essentially polyprotodont.

To the *Field* of December 18 Mr. Douglas Carruthers communicates an article on the big game of Syria, Palestine, and the Sinaitic Peninsula, in regard to which our information has hitherto been defective. He adds the wild goat to the fauna of the district, and confirms Mr. Lydekker's statement as to the absence of the bubal hartebeest, the white oryx, and the addax. Particulars are given with regard to the horn-characters of *Gazella merrilli*, which is shown to be allied to *G. cuvieri* of the Atlas.

A correspondent of the *Yorkshire Weekly Post* of December 11 directs attention to the scheduling by the Westmorland County Council of the hawfinch as a protected bird. This he regards as a grave mistake, seeing that the hawfinch is one of the most mischievous birds against which the gardener has to contend. Reference is also made to the northern extension of the British range of this species, which was formerly unknown in Yorkshire. The writer also directs attention to the danger to birds caused by the ringing system, as it seems that specimens of various species are shot in order to ascertain whether or no their legs are ringed.

In the second and concluding part of his account of the life-history of the American toad, published in the December number of the *American Naturalist*, Mr. N. Miller asks the question why, in spite of the great fertility of the female, the numbers of the species remain practically stationary. Taking the low figure of 8000 eggs as the number in one spawn, it appears that with the exception of two, all these, as well as the whole of the eggs in the other spawns of the same female, must perish if the species remain, as appears to be the case, at the same numerical level. Various water animals, such as dragon-flies, water-beetles and water-bugs, together with their larvæ, newts, and crayfish, appear to be the chief agents in carrying on the work of destruction.

Great interest attaches to the description by Dr. E. L. Trouessart, in the October number of the *Annals and Magazine of Natural History*, of a new representative of the gymnuras, from Sze-chuen, for which the name *Neotetracus sinensis* is proposed. It will be remembered that until recently these remarkable Insectivora were known only by the Burmo-Malay genera Gymnura and Hylomys. A few years ago, however, a third genus, Podogymnura, was described on the evidence of a single specimen from Mount Abou, in the Philippines, and now comes the new Sze-chuen form, which is the smallest of all, and serves to connect the other Gymnurinæ with the Erenaceinæ. It has, in fact, the general appearance of Podogymnura coupled with the dentition of a hedgehog. The genus has been named from the apparent resemblance of the lower jaw to the one from the French Miocene on which was founded the genus Tetracus.

In the *Journal of Hygiene* for November (ix., No. 3) Prof. Hewlett, Mr. Villar, and Mr. Revis discuss the nature of the cellular elements present in milk. They conclude that the majority are not leucocytes, as has generally been supposed, but are derived from the secreting epithelium of the udder. Moreover, vast numbers of these cells may occur in the milk of perfectly healthy cows. Some have considered that these cells (so-called leucocytes or pus-cells), when present in any number, indicate inflammation and suppuration of the udder, but in view of this work such a conclusion does not appear justifiable.

THE growing interest in India among Americans is shown by the fact that the *National Geographic Magazine* for November is largely devoted to a series of excellent photographs illustrating the temples, tombs, and people of the country, by Mr. W. M. Zumbro. It is unfortunate, however, that the titles of the plates and the letterpress were not submitted to the revision of someone more familiar with Indian life and architecture.

"TIDE Tables for the Eastern Coasts of Canada for the Year 1910," by Dr. W. Bell Dawson, have been issued by the Tidal and Current Survey in the Department of Marine and Fisheries, Ottawa. The tables are based upon observations obtained by means of self-registering tide-gauges kept in continuous operation, and, owing to the length of the series of observations, can lay claim to considerable accuracy. The records are reduced by the latest methods of analysis, by which the tidal constants are arrived at, and from these the tables are calculated by the Nautical Almanac Office in London. The paper also includes useful summaries of the more important results of investigations regarding the currents in various regions contained in the reports issued by the Survey; copies of these full reports, illustrated by charts and plates, may be had on application to the department.

A REPORT on the rainfall of the Exe Valley, by Dr. H. R. Mill, forming part of the report of progress in the investigation of rivers, by Dr. A. Strahan and others, is contained in the *Geographical Journal* for December. Owing to the scarcity of long records, Dr. Mill found it necessary to construct maps for four decades between 1868 and 1907 from the data which are summarised in the tables, and to combine these four maps into one of forty years' average by a somewhat laborious process, fully explained in the paper. This map shows that the heaviest rainfall occurs on Dartmoor, where a wide area has more than 70 inches per annum, but that this amount diminishes rapidly in all directions. The general rainfall of the whole of the Exe Valley is shown to be about 42 inches, and nowhere less than 30 inches. Roughly speaking, the Culm and Creedy receive an equal volume of rainfall over their basins, and the Exe three times as much as either. The four ten-year groups of the mean annual rainfall over the whole area show 107, 103, 95, and 95 per cent. of the average; with regard to this, Dr. Mill remarks that he sees no reason for supposing that there is a progressive diminution of the annual amount, though a comparatively dry spell has succeeded a comparatively wet one.

THE geological section of the Belfast Naturalists' Field Club held its first meeting of the winter session on November 24, when one of the members, Mr. James Strachan, delivered a lecture on petrological types of basalt in County Antrim. The chief portion of the lecture was devoted to a suggested rational classification of the basaltic rocks of Co. Antrim according to their varying basicity. Three main classes were recognised, and subdivided as follows:—(1) Basalts without olivine (basaltic andesites): (*a*) flow type, basalt of Spanish Bay, Giant's Causeway; (*b*) intrusive type, dolerite of the Neck at Carnmoney Hill. (2) Olivine basalts: (*a*) flow type, the common olivine-basalt of the district, with olivine increasing from occasional grains to plentiful porphyritic crystals; (*b*) intrusive type, the common olivine-dolerite of the district with varying amount of olivine, *e.g.* dolerite of the Neck at Scawt Hill, and that of Ballygalley Head. (3) Basalts rich in olivine: (*a*) flow type, containing excess of olivine in large phenocrysts, minimum of felspar and augite and colourless interstitial glass; north side of Carnmoney Hill; (*b*) intrusive type, dolerite rich in olivine; Slieve Mish. These types of basaltic rocks were all illustrated by hand-specimens and numerous microscopic sections. In conclusion, the lecturer referred to several peculiar features of the local basalts, such as the fairly common occurrence of "tube-amygdaloid" at the basal portion of many of the Co. Antrim flows, and the complete inclusion of primary minerals, such as felspar and augite, in natrolite and other zeolites.

THE Bausch and Lomb Optical Company, 19 Thavies Inn, E.C., have submitted an improved Störmer viscosimeter for our inspection. In this apparatus a weight falling from rest causes a paddle to rotate in the oil or other liquid to be tested, and a dial registers the number of revolutions made. The time required for a given number of rotations is taken with a stop-watch; it varies with the viscosity of the liquid. Thus, when the apparatus is so adjusted that 100 revolutions in water take 12 seconds, with ether the time is 9·8 seconds, and with glycerine 36·8. The viscosities are reckoned as proportional to the time, that of water being taken as unity. To obviate "spinning" of the liquid a square receptacle is used. Some of the advantages claimed over other types of apparatus are:—(1) Only a small volume of liquid (50 c.c.) is necessary; (2) a determination is made in a few seconds, and can be easily repeated upon the same identical quantity of liquid; (3) the variation due to change of temperature during the operation is practically negligible, since the time is so short; and (4) given spare cups, a series of tests can be made without any waste of time in cleaning the instrument after each experiment. The apparatus is compact, and appears quite easy to manipulate.

THE *Verhandlungen der deutschen physikalischen Gesellschaft* for November 15 contains a critical examination, by Dr. Karl Kurz, of the theories which have been advanced to account for the existence of the penetrating radiation of the nature of γ rays in the atmosphere, and even in vessels hermetically sealed. There are three possible sources of this radiation. It must come either from an extra-terrestrial source, from the earth's atmosphere, or from the material of the earth itself. The author shows that the extra-terrestrial source must be excluded, owing to its leading to consequences in the upper atmosphere which are not in agreement with observations. The atmospheric source he shows to be quite inadequate, the quantity of radio-active matter present being much too small. The radio-active matter present in the soil is, however, not only sufficient to account for the radiation, but gives its intensity correctly as that necessary to produce nine or ten ions per cubic centimetre per second. The semi-diurnal period observed in the amount of radiation the author ascribes to the radio-active matter present in the atmosphere.

THE belief that areas of seismic and volcanic activity move slowly to the west is given a precise form in a paper, by Mr. H. Wehner, which appears in the *Physikalische Zeitschrift* for December 1. He assumes that within the solid crust of the earth, and separated from it by a thin layer of liquid, is a solid nucleus which rotates about the same axis as the outer shell and in the same direction, but with a velocity slightly less than that of the shell, the result being that, with respect to the shell, the nucleus makes one revolution to the west in 952 years. On this revolving nucleus the author assumes there are projecting or "active" spots which in their motion come under weak portions of the crust and cause earthquakes and volcanic disturbances. On this basis he calculates the positions of the active spots on the nucleus which have during the last sixty years produced disturbances notified by ships at sea in the tropical parts of the Atlantic. According to the calculation, these active spots are now nearly all collected under the region between longitude 35° and 41° W., and latitude 1° N. and 1° S., which should therefore be a danger zone. It will be interesting to see if further statistics support this theory.

We have received from Lu-kia-pang, China—which now serves as the magnetic observatory of the Jesuit fathers of Zi-ka-wei—an interesting copy of the record of the great magnetic storm of September 25, with some notes thereon. The storm in China was of similar duration to that experienced in this country, and presented many similar features, but the oscillations were of a much less striking character. The ranges of the declination and vertical force disturbances—about 50′ and 0·002 C.G.S. respectively—were much less than in Europe. The range in horizontal force, however, exceeded 0·005 C.G.S., and the excess may have been large, as the trace was off the sheet during the greater part of the storm. About three hours before the large disturbance began there was a curious little movement, seen in all the elements, which is described in the "Notes" as a precursor of the storm. We understand that movements corresponding to the supposed precursor are distinctly shown on the Kew curves, so that whether related or not to the great storm they seem to have been, like it, experienced all over the world.

The dissociation of hydrobromic and hydriodic acids at high temperatures is the subject of a paper by K. V. v. Falckenstein in the current number of the *Zeitschrift für physikalische Chemie*. The method used is the statical one, first employed by Löwenstein, and is based on the fact that at a high temperature platinum permits the passage of hydrogen, but of no other gas. The action of the red-hot metal may be roughly regarded as a filter, the pores of which are so small that only the very small hydrogen molecules can pass through. The gaseous hydrogen compound, contained in a fused quartz tube and heated in an electric resistance furnace, passes over a platinum bulb, the inside of the latter being connected to a manometer. The pressure of the hydrogen inside the bulb is in equilibrium with the hydrogen outside the bulb arising from the dissociation. Data are given for three temperatures, 1024°, 1108°, and 1222°, in the case of hydrobromic acid, and for two, 1022° and 1217°, for hydriodic acid. Bodenstein and Geiger have measured the E.M.F. at 30° of the cell Br_2—HBr—H_2, and Haber has deduced a formula for the relation between the amount of dissociation of the hydrobromic acid and the temperature. It is interesting to note that the dissociation calculated from this formula, in spite of the large temperature difference between 30° and 1200°, is in very fair agreement with the experimental results described in this paper.

The sixty-sixth annual issue of the Medical Directory, for 1910, published by Messrs. J. and A. Churchill (price 14*s*. net), includes several new features. It appears from the numerical summary that there are 40,558 members of the medical profession, the increase from 1909 to 1910 being 566. The directory includes, for the first time, a section on the principal British spas and climatic health resorts, by Mr. N. H. Forbes. Improvements have also been made in the list of hospitals and other institutions printed at the end of the London section of the directory.

Messrs. Charles Griffin and Co., Ltd., have published a sixth edition of Prof. Grenville A. J. Cole's "Aids in Practical Geology." Alterations have been made in more than a hundred places, and the subject-matter has in this way been brought up to date. While certain modern restrictions in nomenclature have been introduced, the limits of the names of rocks and fossil genera have, as in previous editions, been kept as wide as possible. Prof. Cole's book has been of signal service to very many practical geologists since its first publication in 1890, and in its latest revised form we have no doubt its sphere of usefulness will be extended.

OUR ASTRONOMICAL COLUMN.

Halley's Comet, 1909*c*.—As was briefly stated on p. 239 of our issue of last week, M. Deslandres has added to the large reflector at Meudon a finder, fitted with a moving reticle, which enables the instrument to be used for photographing any faint object moving in relation to the surrounding guiding stars. The aperture of the large reflector is 1 metre, the focal length 3 metres, and an exposure of five minutes, on December 6, 7, and 8, was sufficient to give a sharp image of the comet's central portion. With an hour's exposure the comet was seen, on the negative, as a nebulosity, elongated in the direction opposed to the sun. The finder now in use has an aperture of 15 cm. (6 inches) and a focal length of 2·3 metres, and may be placed on either side of the telescope to suit the convenience of the observer, a suitable counterpoise of the same form being employed on the opposite side.

In conjunction with M. Bernard, M. Deslandres also describes two spectra of the comet secured on December 6 and 8 with exposures of two hours and three hours respectively. That the comet, on December 6, was already emitting its own radiations is shown by the appearance of bright condensations at λ 388 and λ 391·45, as in Morehouse's comet last year. In addition to the nearly circular nucleus, several curved rays, fainter than the nucleus and having the appearance of antennæ, were seen; from their direction it is difficult to account for these rays solely on the assumption that they are produced by solar repulsion. A spectrum taken on December 13 shows the continuous spectrum of the nucleus stronger and the condensations in the ultra-violet larger, the latter radiations evidently emanating from the nebulosity surrounding the nucleus. There is also some evidence for the oscillations of brightness observed at Greenwich (*Comptes rendus*, No. 24, December 13).

Other visual observations of the comet are recorded in No. 4377 of the *Astronomische Nachrichten*, where Prof. A. A. Iwanow also has a paper describing his calculations of the perturbations of the comet's path between 1835 and 1910. His final elements give April 23, 1910, as the probable date of perihelion passage.

An Interesting Sun-spot.—In No. 4377 of the *Astronomische Nachrichten* M. Amaftounsky describes the changes in detail which took place in a sun-spot first seen on the sun's eastern limb on September 27 (September 15 O.S.). Six drawings which accompany the paper show how enormous were the changes, and M. Amaftounsky directs special attention to a marked yellowish-green tint which pervaded the bright tongues, or bridges, over the nucleus and the bright edges of the penumbra. This was not an optical coloration, and, according to the observer, is a very rare phenomenon.

Periods in the Variation of Latitude.—No. 8 of the *Bulletin International de l'Académie des Sciences de Cracovie* (October, p. 543) contains a *résumé*, in French, of a memoir by M. Jan Krassowski, in which the author briefly discusses the results obtained by him in an analysis, by Schuster's "periodogram" method, of the motion of the pole. The data employed consisted of all the results published by the International Latitude Service since 1908. Periods of one-fortieth of a year (9·125 days) were taken, and the values for x and y analysed independently, special attention being paid to the possible demonstration of a yearly period.

The resulting maxima show no trace of an annual period, but there is a weak maximum at thirteen months. A very strongly marked period, of 419·750 days for the x, and 410·625 days for the y, coordinate, was found, and agrees fairly well with the period (428 days) found by Chandler. Another less marked period of 438·0 days also results from M. Krassowski's investigation, and agrees with that found by Mr. Kimura.

THE PLANET VENUS.—In a very interesting lecture, now published in the December number of the *Popular Science Monthly* (vol. lxxv., No. 6, p. 521), Prof. Lowell describes the observations which have been made of the planet Venus, at present so prominent an object in our evening skies. Not only are the observations described, but the results accruing from them are discussed in popular language. Thus the spectroscopic and visual observations are held to have proved that the rotation and revolution of Venus are synchronous, the period being 225 days. A number of drawings accompanying the paper show the permanent markings recorded, and illustrate the unanimity of the observers working under good conditions. The main feature is a number of dark markings which, leaving the limb at different points, converge to the centre, thus giving the planet's disc a cart-wheel appearance.

SUGGESTED OBSERVATIONS OF HALLEY'S COMET.

THE Astronomical and Astrophysical Society of America, through its comet committee, is soliciting cooperation in the observation of Halley's comet at the present return, and has prepared a circular letter of advice that has been widely distributed among observatories with regard to such observations. A copy of this circular will be sent to any astronomer who may desire to use it upon request being made to the chairman of the committee, Prof. G. C. Comstock, Washburn Observatory, Madison, Wisconsin. As many astronomers and other observers of Halley's comet will be interested in the suggestion made by the committee, the circular is here reprinted in a slightly abridged form.

It is desirable that the position of the comet be well observed during the entire period of its visibility, and it seems probable that extra-meridian observations will be secured in sufficient number without especial solicitation. In view, however, of possible large perturbations arising from the close approach of the comet to Venus on May 1, and to the earth on May 18, meridian observations are especially desired during the period in which the comet is sufficiently bright for that purpose. An examination of the amount and character of these comet perturbations and their adaptability to a determination of the mass of the planets producing them has been undertaken by Profs. Leuschner and Crawford, and in case the conditions prove favourable, the meridian determinations may well be supplemented by heliometer observations of the positions of the inner planets with the view of a possible determination of the mass of the comet itself.

The close approach of the comet to the earth promises unusual opportunity for a study of the physical conditions that obtain in such a body, and, as an indispensable basis for such study, the committee recommends a photographic campaign as long and as nearly continuous as possible. The comet's close proximity to the sun's direction at the time of maximum brilliance imposes serious limitations upon this programme, and widely extended cooperation will be required throughout the whole circuit of the earth if this ideal of a continuous photographic record is to be even remotely realised.

About one-third of the earth's circumference in longitude is covered by the Pacific Ocean, within which there is known to exist no observatory with proper facilities for celestial photography. To fill this gap, at least partially, the committee, aided by a grant from the National Academy of Sciences, proposes to send to the Hawaiian Islands an expedition to photograph the comet during the period of its greatest brilliance.

The ends to be served by these photographs, and others obtained elsewhere, are as follows:—

To give a permanent record, as continuous as possible, of the phenomena and changes (1) in the tail of the comet, with special reference to outgoing masses; (2) in the head and nucleus of the comet, particularly as to the formation of envelopes and jets.

The following suggestions as to procedure and precaution in making the photographs have been formulated by Prof. Barnard.

Photography of Comets.

One of the greatest difficulties in photographing the average bright comet is its proximity to the horizon, and consequent projection on a more or less dawn or twilight sky. The effect of this illuminated background with any considerable exposure is to fog the plate to such an extent as either to ruin it or to prevent a proper development of the image of the comet. A difference of three or four minutes in the duration of exposure when the sky is brightest may make a success or a failure of the picture. It is impossible to establish fixed rules as to when the exposure should stop or begin; so much will depend upon the condition of the sky, the position of the comet, the kind of lens, the rapidity of the plates, &c. The best rule is that of the judgment of the observer at the time, and this can only be derived from actual experience in the work.

The plates should be backed with the following to prevent halation. Cook two pounds of white sugar in a saucepan without water until nearly in the caramel stage, then add one pound of burnt sienna. Cook a little more (but not to the candy stage), stirring well. Finally, add about one-half an ounce of alcohol to each pint of backing as a dryer. This backing will keep indefinitely. When it is too hard, moisten it with a little water. This is to be applied to the back of the plate as a stiff paste with a broad camel's-hair brush, and should be applied just before using. A piece of old newspaper pressed upon this will prevent its being rubbed. The face of the plate should be very carefully dusted with a broad camel's-hair brush after it has been placed in the plate-holder. The camera tube should also be frequently wiped out with a damp cloth to avoid dust. Before developing, remove the backing with moist absorbent cotton. If a little remains on the plate it will not injure the developer. In removing the backing be careful to shield the plate from the dark-room light. Do not wet the surface of the plate before pouring on the developer, as it may cause air bubbles on the film; swab it carefully with absorbent cotton at the beginning of development. Develop until the plate is almost opaque to the ordinary developing light. Fix for twenty minutes or more in the ordinary fixing bath (frequently made new), to which has been added a teaspoonful of sodium bisulphite to prevent discoloration.

Lumière Sigma dry plates are recommended, because of their rapidity. Seed 27 Gilt Edge and Cramer Crown are both beautiful plates, but are not now so rapid as the Sigma.

Hydrochinon developer gives a good strong negative, and for astronomical work is excellent. Rodinal in a weakened form, say 1/60 or 1/70 of water, with a longer development, will give a soft and more transparent negative, especially suited for showing the details of the head of the comet on large-scale photographs.

The doublet, or portrait lens, such as is made in America by the Brashear Optical Company and the Alvan Clark Corporation, on account of its wide field, is the best form of instrument for showing the general features of the comet and its tail, and especially for following any outgoing masses that may appear in the tail. One of about 6 inches (15 cm.) aperture will be the most generally used, because of the expense of such instruments. It should be supplemented by several smaller lenses. A "lantern" lens of 1½ inches (4 cm.) aperture and about 6 inches (15 cm.) focus, made by McAllister, of New York, is recommended for showing the extent of the tail. The cost of one of these lantern lenses is seven dollars. It gives a good field of twenty to thirty degrees, especially when diaphragmed down to 1 inch. It is extremely quick for comet work. Its focus should be carefully determined by star trails.

In comet work it is important in all these lenses that the camera should be so adjusted on the mounting with respect to the guiding telescope that the head of the comet can be displaced to one side of the field to secure a greater extension of the tail. Two of the small lenses may be so arranged by a mutual adjustment as to cover the full length of the tail, even though it should be fifty degrees long or more. Although it would thus be in two sections—the head and part of the tail on one plate, and the rest of the tail on the other—there would be no serious objection if the whole tail could thus be secured. The large reflectors will be of the utmost importance in dealing with the detail and structure of the head and envelopes, as has been recently shown at Greenwich.

Until something further is known of the spectrum of the comet, it would be unwise to attempt to give any specific directions as to the duration of exposure required with any telescope. Daniel's comet of 1907, and Morehouse's of 1908, were very different in respect to their photographic activity. The latter was relatively many times more actinic in its light, and hence required much shorter exposures to show the same strength of tail. This information must come from actual experience with the comet. It would seem, however, that the circumstances of the comet's visibility when brightest will make short exposures necessary.

The committee will be pleased to receive from every astronomer who may cooperate in the matter copies (glass positives) of his negatives of Halley's comet, and it will undertake the comparison and discussion of the material thus collected.

Spectroscopic Observations.

For spectroscopic observations of the comet the committee makes the following suggestions, formulated by Prof. Frost. While it may be possible to make visual observations of the comet's spectrum with ocular spectroscopes attached to large telescopes, it is likely that most of the photographic records of the spectrum will be obtained by the objective prism or the slit spectrograph, and reference will be made in what follows to the use of these two types of instrument.

These methods of observation are mutually complementary; for the accurate measurement of wave-length, effect of motion in the line of sight, and analysis of structure of lines or bands (if sufficiently sharp), the slit spectrograph has all the advantages, but for study of distribution of elements in different parts of the comet, and for reaching faint details, the prismatic camera, or objective prism, with its much greater light-power, is essential. The prismatic camera may be employed, with a fair possibility of success, when the comet's brightness is equivalent to that of a ninth- or tenth-magnitude star; the slit spectrograph cannot be hopefully applied before the comet is two or three magnitudes brighter. The size and kind of telescope employed, of course, make such statements relative rather than absolute, and uncertain at best. Too much here depends upon the comet; if its light is chiefly reflected rather than intrinsic, and the continuous spectrum is predominant, then the comet will have to be much brighter for satisfactory spectroscopic analysis than if the light is largely intrinsic and concentrated at half a dozen points in the spectrum. Comets showing sudden and marked fluctuation in size or brightness are likely to exhibit changes in the bright band spectrum.

(1) Prismatic camera or objective prism.

The camera should be a doublet of large angular aperture, 1/4 or 1/5. Useful observations could be secured if the linear aperture is as small as 4 or 5 inches (10 or 12 cm.). The objective prism should be of small angle, perhaps 10° or 15°; if an additional prism is available for the period of the comet's greatest brightness, its angle should be about three times that of the smaller prism. If the doublet is of comparatively short focus, as is likely to be the case, it will be found to be quite sensitive to focus, and separate exposures will be needed for the blue-violet region and the yellow-green region. Optical parts transparent to ultra-violet would be useful, as there may be some important bands of shorter wave-length than λ 3883.

It is very desirable to photograph the spectrum of a star before or after the comet, placing the star at such a point on the reticle of the guiding telescope that the stellar lines may serve for comparison.

Prof. Pickering suggests that an interesting observation would be to photograph the spectrum of a star when seen through the bright portion of the tail, to see if dark absorption lines could be detected.

(2) Slit spectrograph.

A small spectrograph will be a very useful attachment to a photographic doublet as described above. It need not be complicated, and its dispersion may be small. Apparatus for producing a comparison spectrum is not essential, for a neighbouring star of the first type may be brought upon the slit, and its spectrum impressed above and below that of the comet. With one thread of the guiding telescope, or finder, movable, the star can be placed so that its spectrum will fall on the slit as desired. The identity of the cometary band can be thus established better than with the objective prism. After spectrograms of the comet have thus been obtained, it will also be desirable to obtain plates with the slit as narrow as feasible, in order to detect duplicity or complexity of the lines or bands.

Observations with powerful stellar spectrographs of the types in use for determining radial velocities will doubtless be made as soon as the comet's brightness permits, but this is likely to be disappointingly late on account of the heavy loss of light in such instruments. The fixed equipment of these instruments will determine their operation by their regular observers.

Photometric and Polariscopic Observations.

Photometric and polariscopic observations of the comet should certainly be made, although they will doubtless occupy a position of subordinate importance. The suggestions of the committee in this respect are formulated by Prof. Pickering, as follows:—

A great variety of methods may be employed for measuring the light or amount of polarisation of the comet. It is suggested that astronomers undertaking this problem should correspond with the chairman of the committee, in order that uniform methods may be employed throughout by different observers. The plans proposed below may require modification, according to the instruments available.

A direct estimate, by Argelander's method, of the entire light of the comet, as seen by the naked eye, or in the smallest telescope with which it is visible, may have a certain value to observers in the future, although large systematic errors are to be expected in such estimates.

It is doubtful if photometric measures of the nucleus of the comet will have much value, as the results will probably be greatly affected by the coma, and will differ with different photometers and telescopes. If the nucleus be distinctly stellar it may be compared directly with an adjacent star, by means of a double-image photometer. The effect of background would thus be eliminated. Direct measures with a Zöllner photometer, or similar instrument, would probably have but little value, owing to the effect of the coma. Any series by the same observer with the same instrument would be valuable by itself, and the observations by different persons and different instruments might be subsequently adjusted for systematic differences.

The measures described in Harvard Circular 68 showed that the absorption of light by the tail of comet 1902*b* was certainly less than a tenth of a magnitude. Similar measures should be made of Halley's comet. A double-image photometer is indispensable for these measures also, to eliminate the effect of background.

The light of different portions of the tail of the comet may best be measured by the following method. Take two photographs at the same time with similar instruments, using the same kind of plate and developer, and giving equal exposures, taking one in focus and the other out of focus, so that the images of the stars shall appear as circles two or three millimetres in diameter. Make similar enlargements of the two plates, interposing screens of perforated brass. Measures of the opacity of the resulting circular images of different portions of the comet on one plate may be compared with the images of stars the magnitudes of which are known as photographed on the other plate. The effect of the light of the sky or of twilight may thus be eliminated, and the light of the comet compared with that of a star of known magnitude spread over a standard area. The two photographs may also be compared directly with a suitable photometer.

Messrs. Barnard and Frost, having also the benefit of Mr. Parkhurst's opinion, suggest as an alternative and possibly better method the extra focal use of a single camera. The intensity of the extra-focal cometary image could be reduced to the focal plane as accurately as for the star images. The relative values on different nights would always be correct.

Useful suggestions for the photometric observations of the comet may be derived from a paper by Dr. Rosenberg upon photometric observations of the Morehouse comet, contained in the *Astrophysical Journal* for November.

The polarisation, if any, of the comet's tail may best be studied by photographs taken with a camera having a double-image prism placed over the lens. The prism should be turned so that the two images are perpendicular to the direction of the sun. The two images of an unpolarised object should be alike if the correction for colour is the same for both, otherwise it will be necessary to take a second photograph, turning the prism 180°. If the light is polarised, one image may be fainter than the other, as in similar photographs of the solar corona. Measures may be made as described in the preceding paragraph.

Bands will doubtless be seen if the comet is examined by means of a Savart's polariscope or similar instrument, but it is, in that case, difficult to distinguish between slight polarisation of the comet and the strong polarisation of faint sky-light.

Minor Notes.

The following titles may be specified as minor matters not included above, but which may in some circumstances become of importance, viz. :—

The head of the comet should be carefully examined for traces of phase. Possible disturbances may be found in the comet, due to its close approach to Venus on May 1 and to the earth on May 18. A transit of the earth through the comet's tail is possible at or near the latter date, and, if such should occur, a meteoric shower should be looked for and observed with reference to a determination of the meteoritic particles, their frequence, size, &c. Resultant disturbances of the electric potential of the earth's atmosphere are possible, and the cooperation of meteorological observers, and especially of national weather bureaus, is earnestly desired in this connection.

Although the amount of refraction experienced by light in transit through a comet is known to be very small, it seems desirable to make investigation of the matter photographically with long-focus telescopes. The position of a sufficiently bright star near the nucleus, or in the brightest part of the edge of the tail, should be referred to a group of more distant ones, and the resulting position of the star compared with that resulting from another plate exposed after the comet has left the star.

THE HEADMASTERS' CONFERENCE.

THE headmasters of sixty of the leading public schools met at the Leys School, Cambridge, on December 22 and 23. On the first day the chief matter discussed was the work of the Public Schools' League for Imperial Land Settlement in the Overseas Dominions, which was strongly supported by the Rev. Dr. Gray (warden of Bradfield College). Under the auspices of the committee, approved boys are to be sent to a Canadian farm after completing their school career. A course at an agricultural college is to follow a year's practical training on the farm, and it is hoped that the public schools will assist the supply to the dominion of "men of character, intelligence, and energy, possessed of a little capital, who will settle down seriously and will assist in bringing under cultivation the immense areas of land at present untouched." The conference pledged its support to the establishment of a central office in London for the permanent work of the league. Later in the day the meeting asked for fuller recognition of English in the university examinations for admission. All the speakers emphasised the importance of the subject, which was no longer regarded as something for a spare hour; not a few were of opinion that to add English to the entrance examinations would be the worst service they could do to the cause. Fear was expressed lest a set period or figure in literature might be made compulsory, and the comments of some speakers upon the university examinations were decidedly caustic.

On the second day the meeting debated the report of the curriculum committee as to a scheme of studies for schoolboys from the age of nine to about sixteen. The conference passed, practically unanimously, the three following resolutions :—

That this conference approves the principle laid down in the curriculum report of the committee that a boy should not be allowed to begin Greek until the foundations of Latin and French have been securely laid and he has received systematic training in English.

That it is essential to give such a definite position to English and French in the entrance scholarship examinations that these subjects may not be sacrificed to a premature study of Greek; that this meeting be urged to take such steps as will ensure full consideration of the nature and results of the mathematical teaching of boys from nine to sixteen; and that it be referred to a subcommittee to consider and report to this meeting.

That a special meeting of those headmasters who are in favour of the recommendations of the committee be summoned in the early part of next year to take steps to give practical effect in their own schools to the proposals made by the committee, and with this object in view that the secretary be instructed to send a circular to the members of the conference in the third week of January asking whether they are generally in favour of the recommendations of the committee, and, if so, whether they will be prepared to meet in London on a certain date in February or March.

There were several points in the report which were not dealt with in the resolutions, *e.g.* the committee is convinced that German should be excluded from the preparatory school. At the present time the two languages must be Latin and French, in order to provide a basis of education preparatory to classical and modern sides. Dealing with mathematics, the committee reports that in some cases the attempt is made to cover too much ground for the average boy, yet in others there is a danger that mathematics may be sacrificed entirely.

Although reformers will wish that the headmasters had gone further, it is a matter for congratulation that this year's conference exhibited a progressive spirit alike in resolutions and in individual speeches. Not only did the meeting recognise the relation of the public schools to the Empire, but it deprecated early specialisation in Greek, encouraged the advance of English studies, and adopted the principle of differentiating curricula to suit varying capacity. Above all, the headmasters acknowledged the obligation to give practical effect to the opinions which they expressed in conference. Perhaps we may not have to wait many years before drawing, nature-study, music, and handwork are accorded the status of essential subjects in the preparatory curriculum. G. F. D.

WATER SUPPLY IN THE UNITED STATES.[1]

IT is an obvious truism that water is the commonest and most plentiful substance in nature. Oceans, seas, lakes, rivers, floods, and streams innumerable testify to its universality, and its indispensability is no less manifest. Whenever man penetrates into virgin territory, his first care is to find water; wherever civilisation sets up her ultimate standard of health and comfort, she establishes and secures an efficient water supply. Water is the embodiment of all that is delightful in art, useful in industry, valuable to commerce, and essential to existence.

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[1] Water Supply Papers: No. 224 Some Desert Watering Places in South-eastern California and South-western Nevada. By Walter C. Mendenhall. Pp. 98.

No. 228. Water Supply Investigations in the Yukon-Tanana Region, Alaska, 1907 and 1908. By C. C. Covert and C. E. Ellsworth. Pp. 108.

No. 230. Surface Water Supply of Nebraska. By J. C. Stevens. Pp. 251.

No. 231. Geology and Water Resources of the Harvey Basin Region, Oregon. By Gerald A. Waring. Pp. 03.

No. 224. Papers on the Conservation of Water Resources. Pp. 96. (United States Geological Survey. Washington: Government Printing Office 1909)

Hence the interest attaching to these publications of the United States Geological Survey, dry (paradoxical term!), statistical records for the most part, but none the less engrossing in their importance, and even entertaining at not infrequent intervals. Amid a voluminous mass of data, carefully and patiently collected from day to day and year to year, it is surely worthy a passing glance to note that the mean annual rainfall over the United States is 29·4 inches, that the heaviest precipitation occurs upon the North Pacific Coast, where, at several points in the States of Washington and Oregon, it exceeds 100 inches, while at the back of the coastal mountain ranges the rainfall diminishes rapidly southward, so that in the State of Nevada it ceases altogether, or is negligibly small. From another paper comes corroborative evidence on the value of afforestation, in that the data obtained clearly demonstrate the fact that an increase in floods is directly associated with the denudation of forest areas. Again, it is of considerable industrial importance to have an estimate of the total available water horse-power throughout the country. This is stated to lie between 200 and 250 millions, of which only $5\frac{1}{2}$ millions have as yet been utilised. Yet again, from a geological point of view it is instructive to learn that the whole surface of the United States is being denuded at the rate of 1 inch in 760 years, representing an annual transportation of 270 million tons of dissolved matter and 513 million tons of suspended matter to tidal waters.

But the volumes are not merely academically and statistically interesting. They have a human side, which at times is forcible in its suggestiveness. Here and there are touches of the grim reality of things, allusions at once startling and tragic, pictures which bring us face to face with the deadly antagonism to humankind of nature in her more savage aspects. Take, for instance, the pamphlet entitled "Some Desert Watering Places in California and Nebraska." Here are no descriptions of well-watered plains and fertile valleys, but vivid sketches of an arid, desolate region, comprising an area of 68,000 square miles, where "the scarcity of water and the importance of a knowledge of its whereabouts are indicated by the frequency with which the Press records instances of death from thirst in the more remote parts of the desert." The Death Valley region comprises plains which are absolute deserts, totally destitute of water and treeless for a space representing many days' journey. The following extract, under the head of "Getting Lost," gives a vivid sketch of the possibilities of a desert tragedy:—

Death Valley, looking north toward the Black Mountains.

"The inexperienced traveller often gets at once into a panic on losing his way, and wastes his remaining energy in frantic rushes in one direction and another. This tendency to become panic-stricken should be controlled, if possible. Sit down, get out your map and compass—if you are provided with them, as you should be—and study the situation carefully before acting. At least, rest a little and think it over. If it is hot and you are far from camp, get your head into the shade of a bush or rock, and wait till night. Thirst will be less intolerable then and endurance greater. If you have camp companions who are likely to look for you, start a signal fire by night or a smoke by day from some little eminence, and then stay by it till help comes. If you must depend on your own exertions, think carefully over all the possibilities and adopt a plan of action and adhere to it."

Excellent advice! but it is one thing to read it amid the bustle of a crowded city and another to act upon it in the lonely and fearful silence of the illimitable desert.

B. C.

SOME RECENT WORK ON TROPICAL MEDICINE.

TWO recent numbers of the *Annals of Tropical Medicine and Parasitology* (vol. iii., No. 2, October 20, and No. 3, November 1) contain six memoirs, of which four deal with problems relating to trypanosomes and the diseases caused by them. Messrs. Kinghorn and Montgomery discuss the important and difficult question of the flagellates found in the intestine and proboscis of tsetse-flies caught wild, on the basis of observations made by them during their expedition to the Zambezi, 1907–9. In *Glossina palpalis* collected by them on Matondwi Island, at the southern extremity of Lake Tanganyika, an island that has been uninhabited for twenty years, they found, out of 185 flies dissected, no fewer than seventy-eight, or 42·1 per cent., harbouring flagellates in the intestine, a percentage which far surpasses all previous records from other places; no parasites were found, however, in the proboscis. In *Glossina morsitans* collected near Kambole, about fifty miles west of Abercorn, nine out of 113 flies examined, or 7·8 per cent., were found infected with flagellates in the intestine, and seven out of thirty-one flies examined, or 21·2 per cent., were found to contain flagellates in the proboscis.

The authors give a detailed description of the parasites, but, unfortunately, without any figures; they consider that the flagellates observed in *G. palpalis* are to be referred to the type of *Trypanosoma grayi*, Novy, but they did not observe the encystment described by Minchin. The parasites observed in *G. morsitans* only differed slightly from those observed in *G. palpalis*. Feeding experiments were undertaken in order to trace, if possible, a development of the flagellates found in *G. palpalis*, and with rather surprising results, for while 42 per cent. of flies not fed artificially contained trypanosomes, in those fed only a very small proportion were found to harbour these parasites. It was also found that the percentage of intestinal infections tended to decrease when flies were kept in captivity, while, on the other hand, the percentage of infections of the proboscis tended to increase; but the number of cases examined is scarcely sufficient to support these conclusions.

The origin of the trypanosomes occurring in "wild" tsetse-flies is discussed, but without reaching very definite conclusions. The authors agree with Stuhlmann that the parasites in the proboscis are derived from those in the intestine, and they suggest the possibility that the trypanosomes found in "wild" tsetses "may be derived from pathogenic trypanosomes which lose for some unknown reason their infectivity when ingested," and also that they represent a mixed infection.

In two other memoirs the same authors report at length on human trypanosomiasis in north-eastern Rhodesia and Nyasaland, and on trypanosomiasis of domestic stock in north-eastern Rhodesia. The reports contain much valuable information concerning the habits and occurrence of the species of Glossina and other biting flies, the various types of trypanosomes (illustrated by photomicrographs) met with in the blood of diseased domestic animals, and other important points, and the question of prophylactic measures against trypanosomiasis is discussed both for human beings and animals.

In another memoir Messrs. Breinl and Nierenstein give an account of their biochemical and therapeutical studies on trypanosomiasis. After a detailed account of their "observations on experimental trypanosomiasis, the treatment of infections with different pathogenic trypanosomes, and the mechanism of the therapeutical action of various trypanocidal compounds," they raise the question, "When can an animal be considered to be cured?" No very definite answer is given, however, to this question, and it is concluded that "the general condition of experimental animals influences to a large extent the results obtained in therapeutical experiments." The memoir ends with a brief discussion on the comparative value of experiments on different laboratory animals.

The two remaining memoirs are by Prof. John Cardamatis, on sanitary measures and malaria epidemics of Athens, and by H. B. Day and Prof. A. R. Ferguson, on a form of splenomegaly, with hepatic cirrhosis, endemic in Egypt. Both memoirs are illustrated by photographs.

In the *Annals of Tropical Medicine and Parasitology*, vol. iv., part iv., are published two reports of the expedition of the Liverpool School of Tropical Medicine to Jamaica. The first of these reports is by Mr. Robert Newstead, on the ticks and other blood-sucking Arthropoda of Jamaica. The author gives most interesting bionomical notes, as well as systematic descriptions, of these pests, and suggests measures to be taken for the extermination of ticks. The most active enemies of ticks were found to be birds, especially the tinkling grackle (*Quiscalus crassirostris*), the parrot-billed blackbird (*Crotophaga ani*), and the domestic fowl. In the stomach of Crotophaga there were also found specimens of the "green stink-bug" (*Loxa flavicollis*), an observation of great bionomical interest, since this insect, though possessed of an odour which is "horribly offensive," has a protective green coloration. The second report is by Dr. W. T. Prout, on malaria. After discussing the nature and etiology of the disease and its occurrence in Jamaica, the author gives an account of anti-malarial measures and their effects in Jamaica and elsewhere, and suggests practical means for combating the disease.

PRODUCTION AND UTILISATION OF MOLASSES.

THE production of molasses is an important factor in the cane-sugar industry, and has received a good deal of attention in sugar-growing countries. Molasses constitute the thick mother liquor left after the sucrose has crystallised out, and, no matter what artifice be adopted, there is a point beyond which it seems impossible to obtain any more crystals, the sugar being held back by the foreign bodies present. Hertzfeld has shown that the formation of beet-sugar molasses is due to the mineral matter originally present in the juice, or added in the liming process, reacting with the sucrose to form non-crystallisable compounds. Prinsen Geerligs has proved that similar compounds are formed in working up cane sugar. The problem is complicated here by the presence of glucose, which reacts more readily with the mineral substances than does sucrose. In this way is explained the definitely established fact that, the larger the proportion of glucose to mineral matter, the greater the recovery of sugar is likely to be. There appears also to be a physical factor involved; gummy matter is always present, which apparently coats the small crystals and prevents their growth.

The whole subject is discussed very fully in an illuminating article in a recent issue of the *Agricultural News*, one of the publications of the West Indian Department of Agriculture. It is further pointed out that during the past season the muscovado molasses of Antigua and Barbadoes, and to a lesser extent of other West Indian islands, has obtained a remarkably high market price, higher, indeed, than the value of the sucrose present. The chief consumers seem to have been the fishermen and lumbermen on the North American continent. There has been a simultaneous rise in the market value of the exhausted vacuum-pan molasses of Antigua. The problem of storage, therefore, assumes considerable importance; it is complicated by certain bacterial changes which are very liable to set in. But these changes are not inevitable, and with greater care in the manufacture the "souring" which so greatly reduces the market value can be to a large extent avoided. The composition of the various grades of molasses is given as follows:—

	Muscovado molasses (Antigua) per cent.	Centrifugalled first molasses per cent.	Centrifugalled second molasses (exhausted) per cent.
Sucrose ...	50 to 55 ...	40 to 60 ...	20 to 40
Glucose ...	5 ,, 15 ...	7 ,, 20 ...	15 ,, 40
Non-sugar ...	3 ,, 8 ...	— ...	—
Ash	3 ,, 5 ...	3 ,, 6 ...	3 ,, 10
Water	24 ,, 30 ...	25 ,, 28 ...	17 ,, 28

The first molasses can be made to yield a further crop of cane sugar by re-boiling, but the second molasses cannot, and are therefore said to be exhausted.

The problem in Hawaii is very different in character. The molasses obtained there are not of the muscovado type, and consequently have no commercial value as human food. It is estimated that something like fifteen million gallons are obtained annually, of which about ten millions are used as food for stock. There is little doubt that this would be the most economical way of utilising the remainder, but, unfortunately, the number of stock kept on the islands is insufficient for the purpose. Of the other twenty million gallons some is burnt as fuel, some is put on the land as fertiliser, and some is run into the sea and wasted. Decided benefit has followed the use of molasses as fertiliser in Mauritius, and there is some reason to suppose that the sugar increased the amount of nitrogen fixation in the soil; in consequence, the manurial value is higher than one would expect from a consideration merely of the amount of nitrogen and mineral matter present. These favourable results, however, are not obtained in Hawaii, and experiments have been instituted at the Experiment Station of the Hawaiian Sugar-planters' Association to find out whether molasses could profitably be converted into alcohol. Something more than 50 per cent. of sugar is present, of which 83 per cent. can be converted by fermentation into alcohol. The effect of varying conditions has been investigated and the native yeasts described.

THE AUSTRALIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE Australian Association for the Advancement of Science held its inaugural meeting in Sydney in September, 1888, and met there again in 1898; in January, 1890, it visited Melbourne, and again in 1901; since then sessions have been twice held at Adelaide, Hobart, and Brisbane, and once at Christchurch and once at Dunedin, in New Zealand; its next meeting will be held in Sydney in 1911.

As a rule, the meetings have been held in the capitals of the Australian States at intervals of ten years; as the inland towns like Bathurst and Ballarat become larger and better able to provide the requisite meeting-rooms and other accommodation, they will also be visited.

One great disadvantage under which the association suffers is the very great distances which the members have to travel; the nearest meeting-places are between 500 and 600 miles apart, so that members living in Brisbane, Melbourne, and Hobart have to travel those distances to attend a meeting in Sydney, and members from South Australia and New Zealand have to travel about 1200 miles, and those from Western Australia nearly 2500 miles; when the meeting is in New Zealand all the Australian members have to undergo a sea voyage of about five days at least, and some a longer one, with perhaps some hundreds of miles of railway travelling in addition.

People in England do not generally realise these great distances; the above towns appear to be quite close on an ordinary map, especially as the maps of Australia are usually on a much smaller scale than those of Europe and America.

It is partly on account of these great distances that the meetings are no longer held annually, but in alternate years; the yearly expenditure of time and money was too great a tax upon the working members, for, to their credit, it is they who, in spite of these disadvantages, attend the most regularly. The association has, so far, not had funds placed at its disposal to reduce the travelling and other expenses of its members (the British Association has received considerable sums for this purpose when visiting Canada and South Africa); the members, however, are granted return railway tickets for a single fare by the Government railways, and certain of the steamship companies allow a reduction of 20 per cent. off their ordinary fares. The attendance of members and associates has varied from about 600 to nearly 1200.

The Australian Association was founded with the same aims and objects as the British Association, and its rules are very similar; the subscription is lower, viz. 1*l.* for members and 10*s.* for associates (ladies and students) for each session, and there is no longer an entrance fee. The sessions last about a week, and the work is distributed over various sections.

Lectures to working men and others form a popular feature; also garden-parties, conversaziones, and similar social gatherings, which greatly help to bring the members together and afford opportunities to make and renew acquaintances. Local excursions to places of interest and to engineering and other works are also much appreciated, as well as the longer botanical and geological excursions.

The association does a good deal of work by means of special committees for investigation and research; money grants are made to these where necessary from the interest of the research fund (now nearly 3000*l.*), which has been slowly built up from the savings from members' subscriptions, but this has only been rendered possible by the fact that the Australian and New Zealand Governments have liberally provided for the printing of the volume of reports and proceedings. All other expenses are paid for out of the subscriptions, and the excursions are made self-supporting; no funds are provided by the towns visited for the entertainment of the members, as is done for the British Association, but private hospitality is gladly offered to visiting members.

The principal working members are naturally the scientific members of the Australasian universities, societies, museums, Government departments, and other institutions, although, as is seen from the association's publications, many others contribute valuable papers.

There is no doubt that the peripatetic meetings of the association have done much to cause many of the residents in the districts in which it has met to take an interest in scientific matters and do much for its advancement; the effect is also noticeable in the increased output of the original work of the local universities and similar institutions.

One of the greatest benefits of the meetings of the association is that it enables workers to meet and discuss matters of mutual interest, and there is no doubt that this acts as a stimulus of immensely greater value than the reading of even hundreds of pages of printed reports.

The association has one medal to award, viz. that founded in memory of the late Baron von Mueller.

The association has published eleven volumes of reports; these are of about the same size as the annual volumes of the British Association; they are well illustrated by maps, plans, and numerous reproductions of photographs. These volumes are distributed gratuitously to about 300 scientific societies and institutions throughout the world, so that they are fairly accessible to anyone interested in Australasian science, even in places so widely separated as Bucharest, Monte Video, Seoul, Port Louis, and Pietermaritzburg.

As an example of the contents of the volumes, the last report published, viz. that of the Adelaide meeting for 1907 (the report of this year's meeting, held at Brisbane, is now being printed), may be referred to; after the list of officers, sections, committees, and other preliminary matters (thirty-two pages) there is the interesting address by the president, the late Dr. A. W. Howitt, C.M.G., upon personal reminiscences of Central Australia and the Burke and Wills' expedition, which affords a good deal of hitherto unpublished information upon this disastrous expedition; this is followed by the addresses of the presidents of the sections, beginning with Section A, for mathematics, astronomy, and physics, by E. F. J. Love, on the theory of the Voltaic cell; Section B, chemistry and metallurgy, by R. C. Stiehl, on progress in rapid oxidation processes applied to copper smelting, a most important subject in Australia; Section C, geology, by A. Gibb Maitland, Government geologist of Western Australia, on recent advances in the knowledge of the geology of Western Australia; Section D, biology, a century of botanical endeavour in South Australia, by J. H. Maiden, Government botanist of New South Wales; Section E, geography, by Thomas Walker Fowler, upon Australasian geography; Section F, anthropology and philology, by R. Parkinson, of Ralum, Bismarck Archipelago, on totemism and its possible origin; Section G, I., social and statistical science; Section G, II., agriculture, by F. Anderson, professor of mental philosophy, Sydney University, on Liberalism and Socialism, and the outlook of agriculture in Australia, by T. Cherry, Director of Agriculture, Victoria; Section H, engineering and architecture, no address; Section I, sanitary science and hygiene, by Dr. R. Greig-Smith, on air infection; Section J, mental science and education, by Dr. Henry Laurie, professor of mental philosophy, Melbourne University, on materialism and evolution.

Next, on p. 263, follow the reports of committees:—

(1) For the investigation of glacial phenomena in Australasia. This contains the most recent results of the investigations into the Cambrian (?) and Permo-Carboniferous glacial history of South Australia, Victoria, Tasmania, West Australia, and New Zealand, and is supplementary to reports by this committee published in several of the association's previous volumes. (2) For the biological and hydrographical study of the New Zealand coast. (3) On New Zealand food fishes. (4) On terrestrial magnetism in Australia and New Zealand. (5) On seismological phenomena in Australasia. This committee has worked continuously for several years, and has issued several valuable reports. (6) On a uniform system for the nomenclature of igneous rocks in Australasia.

Previous volumes contain other valuable reports from committees upon other subjects; amongst them the following may be mentioned, as they give a general idea of the matters which have engaged, and are still engaging, the attention of the association:—

(1) Upon a uniform system of spelling native names. (2) To inquire into and report upon the teaching of science in primary and secondary schools, technical colleges, and universities. (3) To investigate and report upon the best method of utilising diamond-drill bores for the determination of underground temperatures. Deep bores are being put down in many parts of Australia by the Governments and by private individuals for ordinary water supplies and for irrigation. (4) For collecting and cataloguing geological photographs and surveys. (5) For cataloguing marine Mollusca. (6) For cataloguing the minerals of Australia. (7) To investigate the tides of South Australia. (8) The movements of New Zealand glaciers. (9) The fertilisation of the fig in Australia. (10) On rust in wheat. (11) On Antarctic exploration. (12) On the protection of native birds and animals. (13) On improvements in museums as a means of popular education. (14) On the Adulteration of Food Acts of the Australian Governments. (15) On the chemical compositions and properties of the mineral waters of New Zealand. (16) On the vernacular names of Australian birds.

Next follow the papers read before the sections; several of these, in common with papers in previous volumes, are of a high order, and will be of permanent value. It would be rather difficult to make a selection of these papers, and much space would be occupied by even their titles, but it may perhaps be mentioned that in astronomy, mathematics, and physics there are eleven papers; in chemistry, &c., ten; geology, twenty; biology, eleven;

geography, seven; anthropology and philology, four; social science and statistics, six; agriculture, eight; engineering and architecture, seven; sanitary science and hygiene, nine; and in mental science and education, four; this section is a very popular one with teachers and others interested in education, and the attendance is usually very large.

The association has made several recommendations to the various Australasian Governments and other authorities, and in the majority of cases these have been sympathetically received, and in certain cases carried out. One of the first recommendations was to the British Admiralty, suggesting that the ocean between Australia, New Zealand, and Tasmania should be named the Tasman Sea; this was agreed to, and the name was at once ordered by the Admiralty to be printed on all charts; previous to this there was some difficulty in speaking of this hitherto nameless part of the Pacific.

The association has also made requests for the reservation of certain areas in Australia and New Zealand for the preservation of the native flora and fauna, some of these have been agreed to; a notable one is the reservation of the island upon which the Tuatara lizard is found. Another smaller reservation was that of a sandstone quarry at Bondi, near Sydney, showing a remarkable columnar or prismatic structure.

Amongst other recommendations made at various meetings to the Australian and New Zealand Governments are the following, some of which have been given effect to:—

(1) That the Federal Government should endeavour to obtain data in the Indian Ocean for long-distance weather forecasting.

(2) The installation at Perth, Western Australia, of a complete set of magnetographs for the continuous registration of magnetic variations; also installations at Brisbane, Port Darwin, and Hobart similar to those at Sydney, Melbourne, &c. One has recently been installed at Adelaide in response to the association's suggestions.

(3) That the Australian and New Zealand Governments should adopt additional measures to prevent the further extension of tuberculosis amongst cattle and swine.

(4) Recommending the teaching of hygiene and the medical inspection of school children.

(5) That the New Zealand Government should undertake the magnetic survey of the Macquarie Islands now that the survey of the main islands has been completed.

(6) The Australian Governments were urged to take more effective steps for the conservation of forest areas.

The Federal Government was requested in 1902, before determining upon the site of the Federal capital, to appoint a board, consisting of architects, engineers, surveyors, medical and business men, to inquire and report upon the sites proposed; also to reserve a site for a national museum and for the housing of scientific societies and institutions in the proposed Federal capital. In 1898 successful recommendations were made to the New South Wales Government to proceed with the boring at Funafuti.

So that members may come prepared for the discussions, it has been agreed to arrange for the preparation of papers on subjects of which notice had been given at a previous meeting. Arrangements are being made for the preparation and publication of bibliographies which would be beyond the powers of an unaided individual.

Some of the papers of permanent value might usefully be reproduced in English publications, for in spite of the volumes of reports being widely distributed, a paper published at the Antipodes finds very few readers elsewhere, because on receipt of the volumes by an institution they are usually put on the library shelves, and there they remain.

The desirability of inviting the British Association to visit Australia has been considered and warmly advocated at different times since 1885; a reference to the proposed invitation will be found on p. xxiii of the present volume, in which it was suggested at the Adelaide meeting in 1907 that a sum of 10,000*l*. to 20,000*l*. should be provided to defray part of the travelling expenses of the visitors, and that the invitation should be issued for not earlier than 1913, so as to leave plenty of time to make proper arrangements.

The permanent offices of the Australian Association are in the house of the Royal Society of New South Wales, which has recently provided accommodation for other scientific societies, so as in a small way to afford some of the advantages which Burlington House provides for certain of the English societies; the Sydney societies thus housed have already found much mutual advantage from being under one roof.

A. LIVERSIDGE.

EPIDEMIC DISEASE AMONG THE NORTH AMERICAN INDIANS.

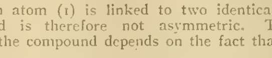
IN the Bulletin of the Johns Hopkins Hospital for November Dr. H. U. Williams discusses the origin of epidemic diseases among the North American Indians.

He believes that these American races developed an extremely small number of infectious maladies. Many of the most deadly kind—small-pox, leprosy, bubonic plague, glanders, anthrax, rabies—were the result of the introduction of infection from Europe. With regard to tuberculosis, diphtheria, influenza, gonorrhœa, beri beri, and malaria, the case is more doubtful; but these maladies do not seem to have been noticed among the native tribes by the earlier explorers. The origin of syphilis and yellow fever alone can with some degree of certainty be assigned to American soil. As contributory causes to this immunity from infection, the dispersion of the tribes in isolated camps, and the lack of domestic animals (the horse being connected with glanders, the cow with tuberculosis, and the goat with Malta fever), may have prevented the spread of disease.

Dr. Williams further attempts to identify the serious epidemic which prevailed on the western coast about 1612–20. When the Puritans appeared on the scene they found this region almost entirely depopulated, and they regarded the epidemic as a dispensation of Providence which had removed the savages to make room for the Europeans. It seems probable that this terrible malady was introduced by foreign settlers. It is very generally supposed to have been an outbreak of small-pox or yellow fever; if this be the case, it is remarkable that the early travellers should not have described it under those names. It is significant that in 1614 that ruffian, Hunt, kidnapped several natives, who were carried to Europe, and after a time those who survived were brought back to their native country. Bubonic plague prevailed in London from 1603 to 1611, and sporadic cases were reported in the following years. The European settlers in America seem to have escaped the disease; and if, as seems most probable, the terrible mortality among the Indians was due to plague, the settlers may have been protected, as in the recent epidemic in India, by the fact that they were cleanlier in their habits and better shod than the native population, and that they were thus less liable to contagion through wounds or insect bites.

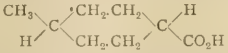
OPTICAL ACTIVITY WITH NO ASYMMETRIC ATOM.

AN important paper by Profs. Perkin, Pope and Wallach on optically active substances containing no asymmetric atom appears in the Chemical Society's Journal for November. The substance described is 1-methyl*cyclo*hexylidene-4-acetic acid, and its structure is represented by the formula



$$\begin{matrix}CH_3 & & CH_2.CH_2 & & & & H\\ & \overset{(1)}{C} & & & \overset{(4)}{C}=\overset{(7)}{C} & & \\ H & & CH_2.CH_2 & & & & CO_2H\end{matrix}.$$

The carbon atom (1) is linked to two identical chains of atoms, and is therefore not asymmetric. The optical activity of the compound depends on the fact that the plane of the $\genfrac{}{}{0pt}{}{CH_3}{H}\!>\!C=$ group is at right angles to the plane of the $=C\!<\!\genfrac{}{}{0pt}{}{H}{CO_2H}$ group, the former being perpendicular to the plane of the hexagonal ring and the latter identical with it; the dissimilarity of the —H and —CH_3 radicles destroys the symmetry on either side of the plane of the ring, whilst the dissimilarity of the —H and —CO_2H groups destroys the symmetry about the perpendicular plane. The compound therefore fulfils the fundamental condition for enantiomorphism, namely, that no plane of symmetry shall exist. By way of contrast it may be noted that the compound



$$\begin{matrix}CH_3 & & CH_2{\cdot}CH_2 & & H\\ & C & & C & \\ H & & CH_2{\cdot}CH_2 & & CO_2H\end{matrix}$$

could not exist in enantiomorphous forms or exhibit optical activity, because the four radicles are all situated in a plane (perpendicular to that of the ring) which would thus form a plane of symmetry of the molecule.

Extraordinary difficulties were encountered in effecting the resolution of the acid. Owing to its weak basicity the salts were very ill-defined, and the brucine salt by means of which the resolution was finally accomplished separated from its solutions as an oil which only slowly became crystalline. Again, the brucine salts of the enantiomorphous acids were so similar that an exceedingly tedious process of re-crystallisation was required before they could be obtained with a constant rotatory power, and even then the acids separated from them were not homogeneous, but proved to be capable of further resolution. Evidently the salts are not only similar, but partially isomorphous. Finally, however, both acids were obtained in a pure state, the *l*-acid giving $[\alpha]_D-81{\cdot}1^\circ$ and the *d*-acid $[\alpha]_D+81{\cdot}4^\circ$ in absolute alcohol (0·145 gr. in 20 c.c.).

TECHNICAL EDUCATION IN MANCHESTER.

THE sixth annual report of the Manchester Education Committee, dealing with the work of the year 1907–8, has now been published, and provides an excellent example of the way in which an educational authority can build up a complete and duly correlated system of education to meet the precise needs of the area under its charge. The report deals fully with higher, secondary, and elementary education.

The section dealing with higher education is concerned with the year ending in October, 1908, and deals chiefly with technical education. The number of individual day and evening students enrolled at the Municipal School of Technology for the session ending July 31 was 5299, as compared with 5149 for the previous session. The number of individual students enrolled in the day departments was 661, as compared with 651 for the session 1906–7. The class entries for the session were 11,379, against 10,979 for the session 1906–7. These figures do not, however, include the class entries in respect of students in the day departments of the school. Computing the total volume of work of the evening departments in student-hours—that is, by multiplying the number of students enrolled by the total number of hours' instruction given during the session—it was found to be 459,805. The actual volume of work, namely, the total number of hours of instruction multiplied by the actual attendances, was 302,162 student-hours, or 60 per cent. of the total volume of work. Whichever method of computation is adopted, the result obtained shows a marked increase on the previous session.

The imperial grant received year by year increases steadily, amounting during 1906–7 to 9773*l*. The capitation grant paid by the Lancashire County Council in respect of students outside the Manchester area was, for 1907–8, 1226*l*. The Cheshire County Council compounds, so far as its students are concerned, and from this source the school received 400*l*.

It is interesting to notice that a certificate has been instituted this year for students attending the engineering apprentices' course, held on Mondays from 9 a.m. to 6 p.m. throughout the session. To satisfy the conditions of award, students must pass all the prescribed examinations upon completion of the two years' course of study. The certificate has now been awarded to thirty-seven students, who have attended the course during the past four sessions. A similar day course for apprentice painters and decorators has also been inaugurated. The committee of the school has had under consideration the question of extending the facilities to apprentices in other industries for instruction and training during one whole day a week, so as to relieve them from attendance at the evening classes, and at the same time to give additional time and opportunity for homework and study in the evening. After consultation with the Master Plumbers' Association of the Manchester and Salford district, a scheme has been drawn up for apprentice plumbers on the same lines as the course for apprentice engineers.

During the past year opportunity has been taken to improve and develop the organised courses of instruction in several of the evening departments in order more thoroughly to systematise the training given, and to bring the various subjects of the respective evening courses into closer organic relation. The courses in the departments of mechanical engineering, electrical engineering, architecture and builders' work, municipal and sanitary engineering, and textile manufacture, are thus graduated and organised to cover a period of three or five years, leading up to the evening certificate or diploma of the school, as the case may be.

A large number of tests has been carried out during the year for various firms in Manchester and district, and the facilities which the school offers for mechanical and electrical tests, and tests and analyses of a chemical nature, are taken advantage of increasingly, as shown by the fees received, which have increased from 119*l*. in 1904–5 to 319*l*. in 1906–7, and 352*l*. in 1907–8. The members of the staff have been responsible during the session for a considerable amount of original research, a large portion of which has been embodied in papers read before various scientific societies, and published in the journals of the scientific and technical Press.

Not only does the committee govern the Municipal School of Technology, but aids higher education in other ways. It recommended to the City Council the grant of 4000*l*. received by the Victoria University of Manchester, and is responsible for the grants received from the council by the secondary schools of the district.

ON THE INVENTION OF THE SLIDE RULE.[1]

SOME modern writers attribute the invention of the rectilinear slide rule to Edmund Gunter, others to William Oughtred, but most of them to Edmund Wingate. This disagreement is due mainly to lack of opportunity to consult original sources. It is the purpose of this paper to demonstrate that Wingate never wrote on the slide rule, and that Oughtred is the inventor of the rectilinear as well as the circular type.

It was pointed out by Prof. De Morgan that Gunter invented Gunter's line or scale, but that he did not invent the slide rule. As Gunter's works are found in most large libraries, the correctness of this statement can be readily verified. This scale was not a slide rule, for it had no sliding parts.

No one denies that William Forster published in London in 1632 a book entitled "The Circles of Proportion," which described the circular slide rule invented by William Oughtred. In the dedication it is said that Oughtred invented also the straight-edge type; but this was not described until 1633, when Forster brought out an "Addition unto the Use of the Instrument," with an appendix entitled "The Declaration of the Two Rulers for Calculation," which described the rectilinear slide rule.[2]

The question remains, Did Wingate invent the straight-edge slide rule, and is he entitled to priority over Oughtred? De Morgan maintained that Wingate never wrote on the slide rule,[3] but he had not seen all of Wingate's books. Thus he admits[4] that he had not examined Wingate's "Of Naturall and Artificiall Arithmetique," 1630, yet this very book is quoted by several recent writers as describing the slide rule[5]; but these and all writers who name Wingate as the inventor invariably fail to give evidence which would show that they had actually seen the book to which they refer. We have gathered information about all Wingate's mathematical books which De Morgan did not examine. We shall state where copies can be found, so that the data given here can be verified by those who are near the libraries named. We take up Wingate's books, one after the other, and show that none contains the slide rule.

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[1] Abstract of a paper, by Prof. F. Cajori, read before the Section of Mathematical and Physical Science of the British Association, Winnipeg, August 27.

[2] For extracts see Cajori, "History of the Logarithmic Slide Rule." (New York: *Engineering News* Publishing Co., 1909.)

[3] "Penny Cyclop.," Art. "Slide Rule," and Wingate, Edmund, "Arithm. Books." Pp. 38, 42. (London, 1847.)

[4] "Arithm. Books,' p. 48.

[5] A. Favaro in "Veneto Istituto Atti" (5), 5, 1878–9, p. 500; Mehmke in "Encyklop. d. Math. Wiss.," vol. i., p. 1054. (Leipzig, 1898–1904.)

(1) "L'Usage de la Règle de Proportion," Paris, 1624. De Morgan's assertion that this book describes nothing more than Gunter's scale[1] is corroborated by P. M. N. Benoit,[2] who examined copies in the Bibliothèque nationale and the Bibliothèque Mazarine in Paris. There is a copy in the Bodleian Library.

Wingate brought out in 1626 in London a translation under the title "Use of the Rule of Proportion." Later editions appeared in 1628, 1645, 1658, and 1683. De Morgan saw the 1645 edition, a copy of which is in the British Museum. Wingate died in 1656.

(2) "Arithmétique logarithmique," Paris, 1626. De Morgan described this book.[3] He saw also the "Logarithmeticall Table," London, 1635, which is anonymous, but is attributed to Wingate.[4]

(3) "Construction and Use of the Line of Proportion," London, 1628. Copy in the British Museum. The "line of proportion" here described is merely a mechanical table of logarithms. There are no sliding parts.

(4) "Of Naturall and Artificiall Arithmetique," London, 1630. Copy in the Bodleian Library. Describes only the instrument named in the preceding text. The first part of this book was enlarged by John Kersey the elder in 1650 under the new title "Arithmetique Made Easie." De Morgan saw the editions of 1673 and 1760.[5] The second part was re-edited by Wingate in 1652. Copy in the British Museum. The instrument described here is still the "line of proportion."

(5) "Ludus Mathematicus," London, 1654, 1681. De Morgan[6] inspected the first edition.

(6) "Use of the Gauge-rod," London, 1658 (second edition).

(7) "The Clarks Tutor for Arithmetick and Writing . . . being the Remains of Edmund Wingate," London, 1671. Copies of both books in the Bodleian Library. Neither contains an account of the slide rule.

MASONRY ARCHES.

A MEMOIR dealing with a subject of great interest to the engineer has recently been issued as a Drapers' Company Research Memoir.[1] It must be admitted that the ordinary treatment of the masonry arch is by no means satisfactory, and therefore any solution of the problem which would give more accurate and trustworthy results without involving excessive labour in the necessary calculations would be welcomed by every engineer who may in the course of his professional duties have to deal with the design and erection of masonry or brick arches.

After discussing the ideal arches for different load conditions, the authors show that for the fairly flat arches of modern practice designed to carry (1) a uniform load per foot run of the rib, or (2) a vertical load rising to a horizontal at a height $l^2/8r+r/6$ above the central line at the crown, the elliptic arch is the proper design.

The rest of the memoir is devoted to an investigation of the extent of the applicability of the elliptic arch. It is shown that for the loads usual in masonry arches the elliptic arch is only closely approximate to the ideal if the ratio of rise to span be small, this latter condition involving large horizontal thrusts and great compressive stresses.

The authors then show that a close approximation to the arch the line of pressure of which coincides with its central line can be obtained with no great labour of calculation, and such an arch they term a pseudo-elliptic arch. The necessary equations to give the required solution are obtained, and an example is worked out in detail to show the application of the method and to prove that the labour of the necessary calculation is not a serious obstacle to the employment of this method. The memoir is illustrated by six plates reproduced from actual drawings.

The applied mathematics department of University College is to be congratulated on this valuable addition to the series of research memoirs dealing with difficult engineering problems for which Prof. Karl Pearson and his students have been responsible. T. H. B.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GRADUATES of the late Royal University of Ireland who desire to be registered as graduates of the Queen's University of Belfast, or enrolled as members of Convocation, should communicate as early as possible with the secretary of the latter University. The first meeting of Convocation must be held within the next four months.

WE learn from *Science* that, according to figures available in the office of the auditor, the University of Chicago holds investments representing permanent endowment that amount to 2,974,000*l*. In addition, its buildings and grounds devoted entirely to university use represent 1,783,540*l*.; equipment, scientific apparatus, furniture, &c., being put at 383,260*l*. additional. These figures do not include the funds destined for the erection of the Harper Memorial Library, estimated in round figures to cost 180,000*l*., nor the cost of the classical building, the construction of which is in contemplation, and on which about 50,000*l*. will be expended.

DR. CHARLES GRAHAM, at one time professor of chemistry at University College, London, and a prominent member of the Society of Chemical Industry, who died on November 13, has left the residue of his estate for medical research. The amount available will probably be 35,000*l*., and it is left to the Senate of the University of London to found a fund, to be known as the Charles Graham Medical Research Fund. The fund is to be applied in aid of any research carried on by a teacher or student of the school of advanced medical studies of the University College Hospital for the prevention, cure, or alleviation of human disease or suffering. If any student or teacher conducts a research which is considered of sufficient merit a gold medal of appropriate value is to be awarded to him. The committee of the school is also to pay to such teacher or student conducting the research an annual sum not exceeding 200*l*. per annum for two years, such person to be known as the "Charles Graham Student in Pathology."

THE Department of Agriculture and Technical Instruction for Ireland has issued a syllabus (Circular 70) of the examination which it proposes to hold in the principles, methods, and history of education, with special reference to science teaching. The examination will be held in June of each year. The examination is provided for candidates seeking recognition of qualification to teach science. Among the subjects included in the syllabus are:—The general characteristics of the curriculum and methods of instruction in science as determined by the laws of general development; the correlation of science with other subjects of the curriculum. The methodology of instruction in science as determined by the laws of development of knowledge; the functions and relations of laboratory work and class-teaching. The critical study of the history of a special branch of science so far as it bears upon the teaching of the subject. The use of note-books and textbooks in science teaching; methods of recording and treating observational data. The construction and use of pictorial illustrations, diagrams, and models; the construction of apparatus. Laboratory organisation and management.

THE "Regulations for Secondary Schools" of the Board of Education lays it down that in all fee-charging secondary schools free places must be offered, under certain conditions, at the beginning of each school year to pupils entering from public elementary schools. The number of such places offered must ordinarily be 25 per cent. of the total number of pupils admitted to the school during the previous year, or, in the case of a new school, at its opening, but this percentage may be reduced or varied by the Board on sufficient grounds in the case of any particular school. A return has just been issued showing the number and names of the fee-charging secondary schools receiving the Board's full grant in which the 25 per cent. of free places has been reduced or varied on grounds deemed sufficient by the Board of Education. The return shows there are 865 secondary schools receiving from the Board the full scale of grant of 5*l.* for each registered pupil between twelve and eighteen years of age. At two of these schools no fees are charged, 746 are required to offer 25 per cent. of free places, and in the remaining 117 a lower percentage is required. The grounds for variation or reduction of the normal percentage of free places fall roughly under three heads, viz. financial circumstances, the fact that there is an adequate provision of free places in neighbouring schools, and the existence of a large percentage of boarders in the school. In fifty-three cases the number of free places has been reduced from 25 per cent. to 10 per cent., in twenty-nine cases to 12·5 per cent., in thirteen cases to 15 per cent., and in all other cases where a reduction has been allowed to 20 per cent.

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[1] "Arithm. Books," p. 42.

[2] "La Règle à Calcul expliquée," p. vi. (Paris, 1853.)

[3] "Penny Cyclop.," Art. "Tables," p. 497.

[4] *Loc. cit.*, p. 498.

[5] "Arithm. Books," pp. 48, 73.

[6] *Op. cit.*, p. 44.

[7] "On a Practical Theory of Elliptic and Pseudo-elliptic Arches, with Special Reference to the Ideal Masonry Arch." By Prof. Karl Pearson, W. D. Reynolds, and W. F. Stanton. Pp. 23+6 plates. Drapers' Company Research Memoirs, Technical Series, VI. (London: Dulau and Co., 1909.) Price 4*s*.

THE eighth annual report, which deals with the work of the year 1908–9, of the executive committee of the Carnegie Trust for the Universities of Scotland has now been issued. The committee states that reports of the independent authorities who have examined the records of the year's work under the research scheme of the trust give evidence that its past success is being well maintained. The committee acknowledges the assistance rendered by the universities in providing the scheme with so many able workers and in affording accommodation and supervision in their various laboratories. We notice that applications for fellowships, scholarships, and grants for 1910–11 must be lodged on or before April 1 next with the secretary of the trust, from whom application forms and regulations can be obtained. The expenditure for 1908–9 upon the scheme of fellowships, scholarships, and grants, and upon the laboratory, was respectively 6861*l.* and 1992*l.*, towards the latter of which the Royal College of Physicians and the Royal College of Surgeons together contributed 1025*l.* The second quinquennial scheme of distribution, which opened with the year under review, besides making contributions of 65,250*l.* to buildings and permanent equipment, and 20,500*l.* to libraries, will at the close of the period of five years have increased the resources of teaching in the four university centres by permanent endowments amounting to 87,500*l.*, while it will at the same time have afforded during the five years an annual income of some 4150*l.* to meet ordinary expenditure. Statistics of the payment of class fees for 1908–9 give the total number of beneficiaries as 3553, the total amount of fees paid as 47,071*l.*, and the average amount of fees paid per beneficiary as 13*l.* 4*s.* 11*d.*, an increase as compared with the preceding academic year of 284 beneficiaries, of 3815*l.* in the total expenditure, and of threepence in the average amount per beneficiary. During the year 257*l.* 10*s.* 6*d.* was refunded voluntarily on behalf of eleven beneficiaries for whom class fees had been paid by the trust.

THE recommendations, made jointly by several of its subcommittees, to the London Education Committee for the organisation of a system of central schools in London have been adopted by the Education Committee, with the exception of a few relating to certain points concerning the teaching staff, and the consideration of these has been deferred. A system of schools is to be established giving an educational course not provided in existing elementary or secondary schools, and the new schools, which will be known as central schools, will have either an industrial or a commercial bias, or both. These schools will take the place of the existing higher elementary and higher grade schools, and will be fed by contributions from surrounding schools, as most of the higher grade schools are at present. The curriculum will provide in all cases for manual and practical work, and, in the case of girls, for instruction in domestic subjects. The curriculum of each school will be considered specially, and be determined with the view of meeting the needs of the district. Pupils will be selected between the ages of eleven and twelve, and parents will be given the opportunity of choosing either a secondary school or a central school for these children. The schools will be organised on a four years' course, and provision will be made for bursaries to be held by pupils on their attaining the age of fourteen. These bursaries will not exceed 500 in number, and will consist of maintenance grants from the age of fourteen at the rate of 10*l.* a year. The total annual cost of this arrangement is estimated at 7500*l.* It is intended that the number of central schools shall be fewer than the present higher elementary and higher grade schools, and shall be carried on under the ordinary regulations of the Board of Education, and in this way be free from the restrictions imposed by the higher elementary schools' regulations. In order that the parents of candidates for admission may be given an opportunity of realising the advantages afforded by the new schools, it is intended to issue a short descriptive pamphlet, and the parents are to be encouraged to seek personal interviews with the school managers and head teachers.

THE eighth annual meeting of the North of England Education Conference will be held at Leeds, in the University buildings, on January 6–8, under the presidency of Sir Nathan Bodington, Vice-Chancellor of the University. The general conference on Friday morning will be devoted to a discussion on the relation of elementary schools to technical schools (day and evening), which will be introduced by papers by Prof. M. E. Sadler, of Manchester, and Mr. James Baker. Mr. J. H. Reynolds and Mr. A. C. Coffin will open the discussion. The subject for the general conference on Saturday morning will be education abroad and in England—a comparison, introduced by papers by Mr. J. C. Medd and Mr. Otto Siepmann, head of the modern languages department, Clifton College. Mr. Cloudesley Brereton and Dr. R. M. Walmsley will open the discussion. The sectional meetings on Friday afternoon will be devoted to the following four topics:—(1) independent study and self-help in schools; (2) co-operation between employers and education authorities; (3) colour-study in relation to general art and to trade, and modern developments of applied art instruction; and (4) the teaching of geography and history in relation to one another. The sectional meetings on Saturday afternoon will be devoted to the four subjects:—(1) physical training in schools, with special reference to the new scheme of the Board of Education; (2) do we teach too many subjects in the primary schools? (3) modern ideas on general art instruction; and (4) the relation of the State to the training of teachers of domestic science, and their relation to the university. The last subject will be introduced by Prof. Smithells, F.R.S., and Miss M. Atkinson. It will be seen that the organising committee has selected a series of topics of wide interest and importance. The principal speakers are experts in their subjects. As a good attendance is already guaranteed, the conference should be one of particular interest and utility. The social side of the conference will be promoted by a conversazione at the University on Thursday evening, January 6, and by a reception by the Lord Mayor in the City Art Gallery on Friday evening, January 7. The usual publishers' exhibition will be liberally accommodated in the large physics laboratory at the University, and the comfort of delegates has been carefully considered in the provision of writing, smoking, and conversation rooms. The technological departments of the University will be open to delegates throughout the conference.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, December 14.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—Dr. F. D. **Welch**: (1) Change of colour in a specimen of *Mellivora ratel* living in the society's gardens; (2) a comparative examination of three living specimens of *Felis tigris sondaica*, with notes on an old Javan male.—Dr. W. E. **Agar**: The nesting habits of the tree-frog, *Phyllomedusa sauvagii*. This frog makes a nest suspended from bushes overhanging a pool, into which the tadpoles drop when they are hatched. The nest is constructed from a number of leaves, the lower ends of which are drawn together and held so by a deposit of empty gelatinous egg-capsules, forming together a thick jelly. After oviposition the nest is closed with a similar mass of empty capsules, so that in a well-made nest not a single egg is exposed to the light and air.—Miss Ruth M. **Harrison** and Miss Margaret **Poole**: Madreporaria collected by Jas. J. Simpson and R. N. Rudmose-Brown from the Mergui Archipelago, Lower Burma, and from the Kerimba Archipelago, Portuguese East Africa.—F. E. **Beddard**: (1) Some notes upon *Boa occidentalis* and *Boa* (*Pelophilus*) *madagascariensis*; (2) notes upon the anatomy of monkeys of the genus Pithecia.—G. A. **Boulenger**: The ophidian genus Grayia. A contribution to the revision of the genus made necessary by an increased knowledge of African snakes.

Linnean Society, December 16.—Prof. E. B. Poulton, F.R.S., vice-president, in the chair.—Rev. T. R. R. **Stebbing**: (1) Report on the Crustacea Isopoda and Tanaidacea collected by Mr. Crossland in the Sudanese Red Sea; (2) Isopoda from the Indian Ocean and British East Africa. Among the Red Sea species, the most interesting novelty is one named *Lanocira latifrons*, in allusion to the peculiar widening of the frontal process. In British East Africa, Wasin has yielded a new genus and species meriting the significant appellation *Kalliapseudes makrothrix*, which may be rendered in the vulgar tongue as the "long-haired beauty of the Apseudidæ." The species is remarkable for the extensive fringes of feathered setæ on the mandibles, maxillipeds, and first gnathopods, as well as for the short, round-ended finger of its second gnathopods. In the Stanley Gardiner collection the new species *Apanthura xenocheir* is unique within its own family in the structure of the hand and finger of the first gnathopods. The new genus and species *Pontógelos aselgókeros*, of the family Eurydicidæ, from Mauritius, displays a prolongation of the first antennæ hitherto unexampled in that family. Several new species and a new genus of Epicaridea, isopods parasitic on other crustaceans, are described from specimens transmitted by Miss M. J. Rathbun, who had extracted them with great care from the crabs of the Stanley Gardiner Expedition. In one instance it proved that the maternal pouch of the parasite was occupied, not by the usual enormous mass of eggs, but by another parasite, probably itself an epicaridean, though strangely metamorphosed.—Prof. G. H. **Carpenter**: Pycnogonida from the Red Sea and Indian Ocean, collected by Mr. Cyril Crossland.—R. **Shelford**: A collection of Blattidæ preserved in amber, from Prussia.—A. W. **Waters**: The Bryozoa from collections made by Mr. C. Crossland, part ii., Cyclostomata, Ctenostomata, and Endoprocta. The collections dealt with only contain sixteen species, and these are nearly all known from the Mediterranean, while nine are British. In this and the previous paper ninety-nine Red Sea species and varieties are referred to; of these, thirty-four are known from the Atlantic, twenty-six from British seas, thirty-nine from the Mediterranean, thirty-four from Indian and neighbouring seas, seventeen from Crossland's Zanzibar collection, eight from Japan, thirty-five from Australia. The classification of the Ctenostomata is examined, and it is considered that the group Stolonifera of Ehlers must be divided into Vesicularina and Stolonifera. In the first there is usually a moderately thick, erect stem from which the zoœcia arise directly, and they all have gizzards, an organ not general in the Ctenostomata and probably confined to this group. In the Stolonifera as now reduced there is a delicate creeping rhizome expanding at intervals, and from these places the zoœcia arise, usually in pairs. There is no gizzard. The gizzards of the Vesicularina usually have a large number of sharp and irregular teeth surrounded by a band of strong muscles, but in Cryptopolyzoon the gizzard has but two teeth with nearly flat edges, called grindstone teeth.

DUBLIN.

Royal Irish Academy, December 13.—Dr. F. A. Tarleton, president, in the chair.—Prof. G. A. J. **Cole**: The "Picture Rock" or "Scribed Rock" near Rathmullan, in the county of Donegal. Attention has been directed to this rock on account of the supposed resemblance of the markings on its surface to casts of the footprints of animals. It proves to be a weathered face of spheroidal diabase (epidiorite), in which prisms of hornblende have developed from the two primary series of joints, and have spread inwards into the rock on either side. The portions of the rock which are thus strengthened to resist denudation stand up like the walls of boxes round about the residual cores of the spheroids, with a deeply weathered interval between them and the spheroids.—Prof. A. W. **Conway**: The motion of an electrified sphere. The problem of the distribution of electricity on a moving spherical conductor was treated, the velocity varying in any manner and the sphere having rotation. Two types of functions, called harmonicoid functions, were introduced, and by their aid a method of approximation to any degree of accuracy was obtained. The stability of the charge was found to be decreased. In quasi-stationary motion with a uniform field of force the distribution remains uniform if there is no Newtonian mass, but, if there is, a "cosine" distribution is produced, the extent depending on the Newtonian mass. In *all cases* the total masses transverse and longitudinal are the same as if the charge were uniform and rigidly attached to the sphere. A conducting electron will have the same dynamical properties as an Abraham electron of the same size and charge.

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THURSDAY, JANUARY 6, 1910.

THE ETHER OF SPACE.

The Ether of Space. By Sir Oliver Lodge, F.R.S. Pp. xvi+156. (London: Harper and Bros., 1909.) Price 2*s.* 6*d.* net.

THIS book is a contribution to what the publishers describe as a "Library of Living Thought." In appealing to Sir Oliver Lodge for a book on the ether they could count on getting something which could certainly be called "thought," in the most exalted sense of the word, and would as certainly be alive. But, notwithstanding the many picturesque images with which the theme is illustrated, we must confess that we have found the book as a whole somewhat unsatisfactory. This is perhaps due to a certain indefiniteness of aim; some sections would seem to be addressed to the cultivated *dilettante,* and dwell at great length on very elementary matters, whilst others can hardly be appreciated except by the expert who is already conversant with the more abstruse parts of electrical and optical theory. Thus the primary notions of aberration are expounded very fully, whilst the theories of Michelson's experiments and of Fresnel's law of wave-velocity in a moving substance are treated with tantalising brevity. Again, the mechanical and optical details of the author's own experiments with the "ether machine" are given with a minuteness which in a work on the present scale rather tends to distract attention from the main point.

The ether has in its not very lengthy history undergone many transformations. The unsatisfactory elastic-solid medium of the last century, with its abundant provision for the explanation of non-existent phenomena, has at length gone, to the general relief. But the newer ether which is gradually being evolved in its place, with its ability to exercise force, and, at the same time, its utter indifference to forces exerted on itself, appears somewhat shadowy and mysterious. When the conceptions are resolved into their elements we are left with little more than what the mathematicians call a "vector-field." It might seem, indeed, that the physicist had only to take one step more, and hand over the whole medium, as a pure abstraction, to the mathematician, who, for his part, is disposed to welcome the gift with enthusiasm as affording, after a few improvements, an unexpected outlet for the theory of groups. His one regret is that he did not (as he confesses he ought to have done) invent the whole thing for himself.

Sir Oliver Lodge, like Lorentz, comes to the brink, but he will not take the plunge. The most interesting parts of this book are those in which he explains the lengths to which he is prepared to go in the effort to retain a mechanical basis for phenomena. He admits, indeed, that ordinary matter is an imposture, but he clings resolutely to something very real and very substantial in the background. He reproduces his recent arguments to show that if the inertia of the atoms of ordinary matter is merely the manifestation of that of a surrounding medium, the density which it is necessary to attribute to the latter is something like 10^{12} that of water. This seems at first sight like a nightmare, but it is in no sense incredible. Waiving details which can have no great influence on the result, it is, indeed, from the author's point of view, mathematically incontestable. He goes on to speculate on the origin of the forces which this medium can exert. Assuming a kinetic theory of force as the only one ultimately acceptable, he sums up his conclusions in a sort of anthem:—

> "Every cubic millimetre of the universal ether of space must possess the equivalent of a thousand tons, and every part of it must be squirming internally with the velocity of light."

It will be seen that the book is in substance a restatement of the author's most recent speculations, in which, of course, he stands by no means alone. If it somehow fails to do full justice to these, and if in some respects the original papers in the *Philosophical Magazine* and elsewhere will probably be found by many to be really easier reading, the auspices under which it is brought out are no doubt partly accountable. The general reader, even if he is disposed to take most things on trust, and does not adopt the critical attitude which the author would himself welcome, will at all events learn to understand the admiration which the scientific world feels for the genius and unflagging spirit with which a most difficult as well as stupendous theme is repeatedly essayed.

H. L.

NEW METHODS OF WEATHER FORECASTING.

Nouvelle Méthode de Prévision du Temps. By Gabriel Guilbert. Pp. xxxviii+343. (Paris: Gauthier-Villars, 1909.)

MONSIEUR GABRIEL GUILBERT, the winner of the prize offered in 1905 by the Société belge d'Astronomie, de Météorologie et de Physique du Globe, for the most successful short-period forecasts of weather, has published in book-form a detailed exposition of the principles underlying his method. He introduces two new principles into the art of weather forecasting, which, so far as we are aware, have not been stated explicitly by any other writer on this subject. First, he invites us to compare the force of the wind at the surface as observed at the various stations contributing to our daily weather reports with the barometric gradient at sea-level. If in any region the observed wind forces are markedly in excess of the normal for the prevailing gradient, a surge of high pressure in the direction of the gradient may be looked for, and *vice versa.* His definition of the word "normal" is entirely conventional. It is based on comparisons made by Clement Ley, Sprung, Köppen, and others, and is that the number expressing the wind force on the Beaufort scale shall be twice that expressing the gradient in millimetres of mercury per degree (111 km.). It follows from this general principle that a depression which is surrounded on all sides by winds in excess of the normal will fill up, whereas a depression surrounded by winds in defect will grow deeper. If the defect is great, a depression of small intensity will develop into a violent storm centre. A depression round which the distribution of wind force as compared with the prevailing gradient is unsymmetrical will move towards the region of "least resistance," *i.e.* the region where the winds are most conspicuously in defect. In identifying the region of least resistance the second principle is also used. It is based on the conception of "divergent" winds. Any wind which has a component directed away from a centre of low pressure is divergent for that centre, and as such marks a region of low resistance to its advance. Generally speaking, the greater the "divergence" the less the "resistance." Strong northerly or north-westerly winds to the eastward of a depression are looked upon as an extreme case of divergence, and as a sure sign of a rapid advance of the depression.

M. Guilbert proceeds to elaborate no fewer than twenty-five rules for forecasting which for the most part follow more or less directly from the two fundamental principles. Their application is illustrated by a large number of examples, taken mostly from cases when the forecasts issued by the Bureau at Paris proved incorrect.

So far as M. Guilbert is concerned, both principles must be looked upon as a direct result of the careful scrutiny of weather maps; they are entirely empirical, and no attempt is made to justify them from general dynamical considerations. Since the book has been in our hands, we have watched the charts published in the Daily Weather Report, and have noticed occasions on which the application of the first principle would apparently have been useful. On other occasions we have found difficulty in applying the rule. On many maps there are, within one and the same meteorological region, winds which are, some in excess, others in defect, of the normal. M. Guilbert gives no instructions as to how to proceed in such cases.

The principle of the "divergent" wind is not likely to be accepted without qualification in the form in which it is put forward. M. Guilbert insists very strongly that a single conspicuously divergent surface wind (observations on mountains or at high levels are expressly ruled out as not being comparable with the surface gradient) must be regarded as an almost infallible indication of the early advance of a depression. Objections based on the argument that surface winds are very liable to be influenced by local conditions are brushed aside. Among the examples quoted in the book there are many instances of surprisingly daring and successful predictions, some apparently *ex post facto*, others attested by stamped postcards as being genuine forecasts made before the event. We are, however, entitled to ask whether the rules might not lead to equally daring but unsuccessful forecasts? Nearly 100 examples are quoted; the number is large, but so is the number of charts from which the selection is made, and it is to be supposed that M. Guilbert, whose style often suggests counsel's address to the jury rather than the judge's summing up, has picked out the cases which best illustrate his points. No doubt he could produce many more instances if called upon to do so, but the multiplication of selected examples does not carry conviction. Before passing judgment we must hear counsel for the other side, who may be able to bring forward a similar number of cases at variance with the principles advanced. M. Guilbert has run up against the old difficulty of expressing his hypothesis in such a manner that it can be tested by an appeal to measurement. The relation between the observed wind velocity and the gradient should lend itself to numerical treatment, seeing that both quantities are the object of regular observation and measurement.

The book is accompanied by a preface by Prof. Bernard Brunhes, the director of the observatory on the Puy de Dôme, who acted as reporter on the occasion of the competition at Liége. In a supplement M. Brunhes points out that M. Guilbert's rules are consistent with the results deduced by Lord Kelvin and Bjerknes for the action of a steady current on a vortex, and describes some laboratory experiments of his own illustrating the phenomena.

MEDICAL EMBRYOLOGY.

Text-book of Embryology. By Dr. Frederick R. Bailey and Adam M. Miller. Pp. xvi+672. (London: J. and A. Churchill, 1909.) Price 21*s.* net.

THIS bulky volume is the third American text-book of embryology that has appeared in recent years. Like Prof. Heisler's work, of which a revised edition was published two years ago, it is addressed primarily to students of medicine and anatomy, being, in fact, based upon the course in embryology given at the medical school of Columbia University. Consequently it differs in its style of treatment from Prof. Lillie's "Development of the Chick," which is apparently intended for zoological students beginning embryology; and whereas Prof. Lillie confines his attention almost exclusively to a single type, and never passes outside the class Aves, the authors of the present volume, although dealing more particularly with human development, have aimed at treating the subject from a comparative standpoint, believing this to be the most efficient way of teaching it. With this opinion most teachers of biology must surely concur. It is satisfactory to note also that the physiology of the developmental processes is not entirely passed over. Thus, in an excellent chapter on the nervous system contributed to this volume by Dr. Oliver S. Strong, the author has been able to include much physiological matter which usually finds no place in a text-book of embryology.

In the second chapter a section is devoted to ovulation and menstruation and the relation which subsists between these processes, but it is to be regretted that the comparative method which is so successfully followed in other parts of the work is not extended to the problems dealt with here. That menstruation in the Primates is the physiological homologue of the prodestrum in the lower Mammalia, and that in the latter ovulation occurs normally during œstrus, are now generally accepted facts, the recognition of which has removed many apparent difficulties which used to perplex the older writers.

Messrs. Bailey and Miller quote Leopold's observations, but they omit to mention that the later investigations of Heape, Sobotta, and others have thrown a new light on the subject. In this connection reference may be made also to the recently published memoir by Bryce and Teacher, whose conclusions in regard to the usual time for ovulation in man are in general agreement with those arrived at by investigators of the sexual processes in the lower Mammalia.

The authors state that the discharged follicle "becomes organised by ingrowth of vessels from the theca to form the corpus hæmorrhagicum" (p. 32). The latter name is more correctly applied to the follicle when it contains a blood-clot, as happens frequently (but by no means invariably) after ovulation, and the term is used in this sense on a later page (p. 413). The cells of the membrana granulosa do not actively proliferate before becoming luteal cells, as stated here (pp. 32 and 413), but undergo a process of simple hypertrophy. Cell-division in this layer is extremely rare after ovulation has taken place.

The authors lay due stress on the fact that the ovaries are ductless glands, not only physiologically and anatomically, but also developmentally. On a later page (p. 437) they make the statement that congenital absence of the ovaries may occur without defects in the other generative organs. We do not know on what authority this observation is cited, and in view of the fact that the uterus undergoes atrophy after ovariotomy (or remains infantile if the operation is performed in early life), the statement seems on the face of it unlikely.

The question as to the determination of sex is discussed at some length, and the recent observations of Wilson, McClung, Morgan, and Correns are referred to. Some of the older experiments on feeding caterpillars, tadpoles, &c., are also described, but the authors do not mention that the evidence derived from these has been to a large extent invalidated by the recent work of Cuénot, Kellogg, and others.

The book is divided into two parts, the first dealing with general development, including the development of the external form of the body, while the second is devoted to organogenesis. The sections at the ends of the chapters, treating of the origin of malformations and developmental anomalies, are a special feature. Moreover, there is a final chapter on teratogenesis, in which the views of Beard, Mall, and others are duly referred to. Suggestions for practical work, with descriptions of the necessary technique, are also included.

There are a few minor errors. For example, on p. 115, "Fig. 107" is a misprint for "Fig. 108," and on p. 416 "Girou" is wrongly written "Giron."

Among the more noteworthy omissions are absence of reference to the "phylogenetic law" (commonly but erroneously called the law of von Baer), excepting for a passing mention on p. 387, Miss Lane Claypon's work on the origin of ova from ovarian interstitial cells during adult life, Herring's researches on the development of the pituitary, and Gaskell's work on "The Origin of Vertebrates," which, with all its wealth of detail and illustration, morphologists cannot afford to ignore. However, much valuable and important matter is included, and the volume as a whole forms a useful addition to the literature of medical embryology.

FRANCIS H. A. MARSHALL.

FUNDAMENTAL PROBLEMS OF PSYCHIATRY.

Modern Problems in Psychiatry. By Prof. E. Lugaro. Translated by Dr. David Orr and Dr. E. G. Rows. Pp. vii+305. (Manchester: University Press, 1909.) Price 7*s*. 6*d*. net.

THIS translation will be welcomed by those who are interested in the study of mental disease, but have been unable to read the original Italian work. The book is intended to pass in review the chief fundamental problems which present themselves to the student of psychiatry. As the author states in his preface, the latter must be a man of extensive knowledge, since his study carries him into the most difficult branches of anatomy, physiology, pathology, psychology, sociology and even criminology. The author also hints that one object of his book is to justify the claim of psychiatry to a place among the sciences and by the side of general medicine, and to remove from the public mind the existing prejudice against the study of mental disorders. The work is, however, surely too learned a disquisition to engage the attention of an ordinary layman. We regret to find that the author himself draws a distinction between physicians and "alienists" (p. 71), as if so-called "alienists" were not physicians; yet we understand that even in Italy psychiatry is a well-recognised branch of medicine.

While admitting that it is still necessary at the present day to define clearly one's position in relation to metaphysical doctrines, we consider that Prof. Lugaro is too respectful to effete hypotheses of the nature of mind in devoting so much space to dismissing them. His final attitude is that he accepts the external world as an existing reality independent of our experience of it; while consciousness he regards as coinciding, perhaps identical, with experience; whether the experience be that of the philosopher, peasant, child or brute. This mode of regarding consciousness he designates "primitive realism."

The book as a whole strikes one as the work of a pathologist and anatomist with but limited clinical experience. The chapters on anatomical, physiological and allied problems should claim the attention of every asylum physician; those on pathogenesis and etiology are not so strong, but they repay perusal.

In the anatomical section the researches of Ramon y Cajal, Nissl, Brodmann and Vogt on the histology of the cortex are passed in review, but we note with regret that the excellent work of Campbell is not even mentioned. Similarly, in the physiological section we regard it as an important omission that no reference is made to Sherrington's researches.

Prof. Lugaro is a believer in the utility of hypotheses. "If a hypothesis starts from assured facts and involves no errors of reasoning, it has as much value as the observation from which it takes origin," and "even the observations on which it is based acquire greater force." Accordingly we are here and there treated to a useful hypothesis. For example, the fact that the first collaterals from the axon of a cortical projection neuron are directed back to the cortex means for Lugaro that neighbouring neurons are stimulated to participate in the action of the first neuron, and that the function of these particular collaterals is to diffuse stimuli.

The superficial layer of the cerebral cortex is regarded as associational in function, the middle layer as motor, and the deep layer as sensory. It appears that the very deepest layer of the cortex, the destruction of which gives rise to the remarkable syndrome known as dementia precox, is normally developed much more in man than in lower animals, even the highest apes. We note, by the way, that the author regards the neuroglia as an anti-toxic substance, since it reacts more than the true nervous tissue to toxic substances.

The author very properly decries, on the one hand, the superficial methods of examination of insane patients as practised in most asylums and, on the other, the systematic examination by a hundred or more tests employed by certain enthusiastic plodders. The first is desultory and can never advance the science of psychiatry one whit, while the second is unpractical. Kraepelin's methods meet with the professor's approval.

On p. 64 Lugaro expresses the view that the manifestations of insanity at times defy comparison with normal processes, but here we would accuse him of failing to see below the surface; a normal instinct may be compared with its distorted self in disease, and any normal mental function may fitly be compared with its absence where such absence constitutes a positive symptom.

The author's views respecting heredity are rather heterodox. He starts with the premiss that the tendency of heredity is to improve the race, and appears to conclude therefrom that heredity is an over-estimated factor in the causation of insanity. He has some difficulty in rejecting the possibility of acquired characteristics being transmitted but, after a long discussion of the matter, appears finally forced to do so.

Private asylums receive some severe criticism. These institutions in Italy are apparently in a parlous state; but many in England come well beneath the ban, and this part of the book should not be read in a pharisaical mood.

The work should be on the shelf of every pathologist and asylum physician; it is thoughtful, suggestive and well written. The translation also is excellent, but there are a few infinitives that might with advantage be unsplit when the next edition appears, as it undoubtedly will.

THE AUTOBIOGRAPHY OF N. S. SHALER.

The Autobiography of Nathaniel Southgate Shaler, with a Supplementary Memoir by his Wife. Pp. x+482. (Boston and New York: Houghton Mifflin Company, 1909.) Price 16*s.* net.

THE keynote of this book is to be found in its final lines, written to Mrs. Shaler by Prof. G. H. Palmer:—

"How large your companionship with him was your words in this volume, and elsewhere, show. Happy woman to have been so blest, and happy we who were allowed to know you both!"

The book is the outcome of a personal relationship, which pervades it, but which does not obtrude upon the reader. We are spared the emotional and sometimes spiteful passages which are supposed in so many biographies to add vitality to the story of a married life. We gather instead a sense of peace, such as comes from long-continued good work, jointly and perseveringly performed. But we do not get to know Shaler through these pages as generations of Harvard students knew him. Prof. W. H. Hobbs, indeed, wrote two years ago:—

"It would be necessary to secure a composite of the memory picture of literally thousands of students in order adequately to present the characteristics of this truly remarkable man to one who had never known him."

It was the man himself, a fighter from his youth, vigorous, virile, yet painstaking in a high degree, that established his claim on others, rather than the work he did. Hence his autobiography, which ends in 1861, and the modestly entitled "supplementary memoir," which covers the remaining forty-five years of his life, will be read with most pleasure by those to whom passage after passage will recall some familiar trait, some habit, perhaps some manner of speech, impossible to set down in print.

As an account of a life spent in transition times, when the easy-going, slave-tended society of the south was about to organise itself for a strife of heroes, the autobiography leaves us somewhat cold. We have useful glimpses, however, of Louis Agassiz, then dominating the natural science course at Harvard, and the anecdotes of his methods as a curator and an examiner (pp. 93–104, and 189–92) will please those called to similar duties. Young Shaler, studying fishes under his care, was left to describe what he could observe for himself, and was merely told when he was wrong; whereupon he would begin again, and so on, until his master found that the results tallied with his own. The impression made by Agassiz in denouncing the Darwin-Wallace school is well shown by the story of his pupil Stimpson (p. 129), who, when convinced that he had found intermediate links among molluscan species, ground "one of these vexatious shapes" to powder with his heel, remarking, "That's the proper way to serve a damned transitional form."

Shaler, of course, soon accepted the new views. He studied zoology practically, by dredging, fishing, and shooting, though he much disliked killing animals; and he was thus engaged, in his twentieth year, when the men of his native State, Kentucky, had to decide for or against the Union. The movement in the south was regarded as desultory; even if it continued, it was not going to reach Kentucky for some years; and Shaler set off with Hyatt in 1861 for a sail of several months about the mouth of the St. Lawrence. This peaceful campaign, with its scientific aims, involving a rough-and-tumble life on a small boat, prepared him for many a future struggle.

Shaler returned from it to find even neutral Kentucky divided within itself; and soon, though the chief actor tells us nothing of it, "Shaler's battery" became known upon the Union side.

Shaler married in 1862; but his wife refers us to his various writings on the war, and quotes very little from letters written to her from the field. The advance of Rosecrans on Nashville left Kentucky outside the crash of armies, and no echo reaches us of the bitter days round Chattanooga. It is of far more importance to Mrs. Shaler to record—and this was probably the feeling of all who knew her husband—that in 1864 Shaler was appointed assistant in palæontology in Harvard University. In 1869 he became professor of this subject, when only twenty-eight; then he was made professor of geology; and in 1891 he was chosen as Dean of the Lawrence Scientific School. Even his position from 1874 to 1880 as Director of the Geological Survey of Kentucky did not break his connection with the development of Harvard. For more than forty years, down to his death in 1906, he was one of the most familiar figures in the courts of the university.

Chapter xix., which deals with a visit to England, contains characteristic mention of Tyndall, and of several English geologists. Here, as in other places, some proper names have gone astray. The Rev. Mr. Simons of p. 256—have we not made the same rural journey to enjoy a meeting at his gate?—must surely be the late W. S. Symonds, the friend of all naturalists in the Midlands. Elsewhere we have "Renivier," "Guinitz," "Geoffrys" for Jeffreys, and "Marais," as we may presume, for "Marey." These slips result from copying out of diaries, where the incidents of the day have been set down. The incidents thus recorded, page after page, seem rarely of value in themselves; yet it is clear that we may end this notice much as we began. To those for whom the book is written, those whom Shaler had helped or stood by as a friend, nothing about Shaler will seem unworthy to be expressed. GRENVILLE A. J. COLE.

MATHEMATICAL TEXT-BOOKS.

(1) *Geometry for Beginners.* By C. Godfrey and A. W. Siddons. Pp. x+79. (Cambridge: University Press, 1909.) Price 1s.

(2) *The School Geometry.* Parts i. and ii. By W. P. Workman and A. G. Cracknell. Part i., pp. viii+248. Part ii., pp. viii+(233–383). (Cambridge: University Tutorial Press, Ltd., 1909.) Price 2s. each part.

(3) *Coordinate Geometry.* By H. B. Fine and H. D. Thompson. Pp. viii+300. (London: Macmillan and Co., Ltd., 1909.) Price 6s. 6d. net.

(4) *Exercise Papers in Elementary Algebra.* By the Rev. E. M. Radford. Pp. viii+112. (London: J. M. Dent and Co., 1909.)

(5) *Problem Papers in Mathematics.* By R. C. Fawdry. Pp. vii+240. (London: Macmillan and Co., Ltd., 1909.) Price 4s. 6d.

(1) IN the light of the experience gained in the last eight years or more, it is now possible to estimate, with considerable accuracy, the effect of the numerous changes which have been made in the methods of teaching elementary geometry. The circular issued by the Board of Education last March contains a report on this subject which is well worth careful perusal. The central feature of the modern movement has been an attempt to familiarise the pupil with the fundamental concepts by experimental methods, before providing him with formal proofs. It is now suggested that this experimental stage, by being made more systematic, should *replace* the first part of the present deductive course. The properties of parallel lines and congruent triangles possess a characteristic which pertains to few, if any, of the later theorems. Once a pupil clearly apprehends their significance, which is possible only by experimental work, he is convinced with absolute assurance of their truth; and this very fact only serves to increase the difficulties which surround the formal proof. In the words of the circular,

> "to commence the subject by proving what seems to need no proof is a safe way to make boys think that the whole subject is artificial and unreal. It is much better to begin Euclidean, that is, deductive proofs at the point where their necessity can be appreciated—that is after these fundamental propositions—and where, therefore, the proof is a natural process, not subject to arbitrary or artificial rules."

If then these base-theorems are incorporated in the experimental stage, and if at the end of this course those fundamental concepts, which have been thereby assimilated, are allowed to be assumed without formal proof, the course of deductive geometry will open with the properties of areas of triangles and parallelograms, and continue with theorems on the circle. In this way, at the end of his first year, a pupil will have covered as much ground as at present is covered, in the majority of cases, only after two or three years.

The present excellent little volume has been compiled to cover the complete experimental course outlined above, and it follows in every respect, save one, the suggestions made by the Board of Education. It is, however, advised in the circular that riders should be excluded entirely from the experimental stage; although in this way time may be saved and greater emphasis placed upon the fundamental theorems, yet simple riders so frequently serve to illustrate a theorem, and, moreover, form a valuable introduction to the future deductive course, that we are firmly convinced that the authors are right in inserting a large number of easy deductive examples in the text. We have developed these considerations at some length, because we consider that the change now advocated is likely to exert a profound influence on the teaching of geometry, and that the more it is considered in all its bearings, the more advantageous it will appear.

(2) This is an abridged edition of the authors' work, entitled "Geometry: Theoretical and Practical," published about two years ago. In the present book a certain amount of theory which may be fairly considered to be beyond the range of the average schoolboy has been omitted. The sequence adopted in the theoretical course is that of the Cambridge syllabus. Part i. contains the substance of Euclid books i., iii.; part ii. that of books ii., iv., vi., together with those

modern extensions, such as harmonic ranges and coaxal circles, which now form a customary part of the school course.

(3) In this treatise the elements of coordinate geometry are presented in a compact form. The first twelve chapters are devoted to the treatment of the line, circle, conic, and other curves, while the remaining six deal with the line in space and the surfaces of the second degree. The experience of the authors has led them to introduce a number of changes in the order of development of the subject. The equation of the straight line is given, before the customary work on lengths and areas; they advise the student to read the chapter on the parabola before that on the circle, thereby enabling him to see at an early stage how analytical methods may be used to obtain properties which are new to him. All mention of pole and polar properties is deferred until after the treatment of the general conic, and the application of Cartesian methods to the investigation of loci is postponed to the final chapter of the first part of the book.

The section on solid geometry, while omitting the more complicated analytical formulæ, is sufficiently thorough to enable the student to attack with success any problem on the geometry of the conicoid of a straightforward character. There are numerous exercises and diagrams. In every respect this book is admirably suited to meet the needs of those who are reading the subject for the first time.

(4) The range of work covered by Mr. Radford's useful book includes the binomial theorem and the exponential and logarithmic expansions. Quadratic equations and graphical solutions are introduced at the start, and logarithms appear at an early stage. There are also ten book-work papers.

(5) The papers set in recent examinations conducted by the Civil Service Commissioners have included a number of problems of a much more practical character than are to be found in the ordinary academic text-book. That this type of question is both stimulating and of real educational value is beyond question, but up to the present there has been no convenient collection of problems of this character. Mr. Fawdry's book now supplies exactly what is wanted. Primarily, it is intended for army candidates and students in technical colleges, but many of the papers contain practical questions of considerable intrinsic theoretical difficulty, and may therefore profitably be set to boys preparing for entrance college scholarships. A comprehensive set of revision papers adds materially to the utility of this first-rate book.

OUR BOOK SHELF.

Ant Communities and How they are Governed. A Study in Natural Civics. By Dr. H. C. McCook. Pp. xvii+321. (New York and London: Harper and Bros., 1909.) Price 7*s.* 6*d.* net.

FOR thirty-two years Dr. McCook has devoted much time and attention to the habits of American ants, and has published many popular works on the subject, in addition to the two large works on "The Agricultural Ants of Texas" and "The Honey Ants of the Garden of the Gods." In the present work, which is based chiefly on his own original observations, he discusses the conditions of ant-life from a popular standpoint; and his sixteen chapters deal with such subjects as fraternal confederacies, nesting architecture, engineering, feeding the commune, language, government, dependents, war, aliens, aphis herds, slave-making, sanitation, &c.

Britain is very deficient, both as regards number of species and number of individuals; but the American species are more numerous, and the size of nests and communities of many species is almost incredible. Thus Dr. McCook writes:—"The large conical nests of the mound-making ants of the Alleghanies, *Formica exsectoides* vary in size from newly-begun colonies a few inches high to mature hills, measuring thirty-seven feet in circumference at the base, though rarely more than three feet high. They occur in groups, and in one site near Hollidaysburg, Pennsylvania, within a space of fifty acres, the writer counted seventeen hundred well-developed mounds. At two other localities in these mountains, similar groups were observed even more thickly placed. At "Pine Hill," about thirty acres were occupied, of which five were found to contain two hundred and ninety-three mounds, an average of fifty-nine to the acre, or eighteen hundred for the whole section. At "Warrior's Mark," another large settlement of nearly two hundred hills was visited. Experiments made in the Hollidaysburg group proved that all therein formed substantially one community, in complete fellowship, although the individual mounds appeared to be conducted independently" (pp. 3–5).

Dr. Forel's comment on these observations is:—"These ant kingdoms have in all probability a population of two hundred to four hundred million inhabitants, all forming a single community, and living together in active and friendly intercourse" (quoted at p. 8).

Again, with reference to the cutting ants of Texas, we read:—"A planter, in order to get rid of the depredations of an immense commune near his residence, had set his men to dig it up and utterly root it out. In order to reach the central nest he had traced the ants from a tree inside his home premises, which they had stripped of leaves, to a point six hundred and sixty-nine feet distant. The nest occupied a space as large as a small cellar, the lowest and main cave being as large as a flour-barrel. In this central cavern were great numbers of winged males and females, and innumerable larvæ and workers. From this point radiated the various avenues over which the leaf-cutters marched on their raids" (p. 64).

We could quote equally interesting passages from almost every page of this fascinating volume; but before concluding, we may note that Dr. McCook attaches great importance to the sense of smell in ants.

The numerous text-illustrations are of unusual excellence.

Sextant Errors. By Thos. Y. Baker. Pp. 32. (London: J. Griffin and Co., 1909.) Price 1*s.* net.

MR. BAKER has supplied a very excellent shillingsworth for those who have occasion to use the sextant and wish to understand it properly. Every text-book gives the simple theory of the instrument, and the more ordinary adjustments and tests for errors are generally enough understood, but when the complete theory of an astronomical instrument, worked out on the supposition that no part is quite perfectly made, is required, then only such elaborate books as, for instance, Chauvenet may be turned to with confidence. It will be a great convenience to the sextant user to find in this little book complete demonstrations, free from the usual omission of steps, unnecessary for the writer of the book, but sadly needed by the reader, of the important errors, with specially prepared tables to facilitate calculation.

The extreme importance of the collimation error and its surprising possible magnitude are pointed out, and a very neat way of ascertaining if the telescopic axis is perpendicular to the index mirror when the arm is suitably turned is described, but it is unfortunate that this is not available in all sextants as made.

One fault must be insisted on. The use of the signs ′ and ″ for feet and inches instead of the abbreviations ft. and in. is bad enough when used by engineers, but then it is rare that there is fear of confusion. The author, however, gratuitously causes confusion in a book which is bristling with the signs ′ and ″ in their proper meaning by using the symbol ″ for inches even in the same sentence with ″ in its proper meaning. It is to be hoped that this and one or two typographical errors will be corrected in a future edition.

C. V. B.

The British Journal Photographic Almanac, 1910. Edited by George E. Brown. Pp. 1320. (London: Henry Greenwood and Co.) Price 1*s.*

THE present issue of this very useful volume is drawn up on the same lines as those of its immediate predecessor, and its contents are of the usual essence of photographic matter on all topics, which makes it such a valuable *aide mémoire* to the working photographer. Commencing with the usual calendar, which begins on p. 407, and not on p. 447 (as it is incorrectly indexed, by the way), there follows the useful directory of photographic societies and bodies. An interesting chapter on lens calculations by mental arithmetic, written by the editor, precedes the large section on the epitome of progress by the same authority. This latter portion is always one of the chief contributions to the volume. Then follows a description of the recent novelties in apparatus, which occupies nearly 100 pages. Formulæ for the principal photographic processes, the developing formulæ of the principal plate and paper makers, miscellaneous information, and the usual large number of valuable chemical, exposure, optical, and other tables, bring the volume to a conclusion.

Another feature of this publication, and one which is so often referred to by those who have the book in their possession, is the excellently indexed mass of advertisements in which the main text of the book is sandwiched.

The volume should find its usual place in every photographer's library.

Outlines of Bacteriology (Technical and Agricultural). By Dr. David Ellis. Pp. xii+262. (London: Longmans, Green and Co., 1909.) Price 7*s.* 6*d.* net.

THE general plan of this book is excellent, but we doubt if the various subjects are dealt with in sufficient detail to render the book of much practical utility to the student. To attempt to deal with disease-producing organisms and all the technical applications of bacteriology in 260 short pages is an impossible task if anything more than general principles is to be considered.

The contents of the book include the general morphology and biology of the bacteria, a subject to which the author has himself contributed, sterilisation, pathogenic bacteria, sulphur and iron bacteria, preservation of food products, nitrification, fermentation and ferments, and their industrial applications (*e.g.* beer, butter, cheese, tanning, tobacco, &c.), and sewage disposal.

Unfortunately, a number of errors disfigure the text. Thus on p. 109 a classification of proteids is given in which one class is termed "amyloids" and is stated to be insoluble in gastric juice, globulins are said to be soluble in dilute acids, and casein is given as an example of a derived albumin, and is said to be soluble in dilute acids. A number of mistakes also occur in the section dealing with pathogenic organisms. In the section on the preservation of food-stuffs by heat, while canning is mentioned, there is no reference to the sterilisation or the pasteurisation of milk. The names of plants yielding flax, hemp, jute, &c., are not correctly given, and on p. 245 a paragraph dealing with the *Bacillus enteritidis* of Gärtner is hopelessly wrong.

The book is clearly printed, and illustrated with a number of figures. Many of these are very diagrammatic and drawn to no scale, so that the reader sees the anthrax bacillus and influenza bacillus depicted about the same size, which is somewhat misleading.

R. T. HEWLETT.

A Descriptive Catalogue of the Dobrée Collection of European Noctuae. Compiled by H. B. Browne. Hull Museum Publications, No. 63. Pp. xv+156. (Hull: A. Brown and Sons, Ltd., 1909.) Price 1*s.* net.

THE late Nicholas Frank Dobrée, of the New Walk, Beverley, who died in 1908, at the age of seventy-seven, formed a very valuable collection of Palæarctic Noctuæ between the years 1871 and 1888, which he subsequently presented to Hull Museum, on the understanding that a complete catalogue should be published. We presume that it will be preserved intact, for we are convinced that special collections of all kinds, whether literary or scientific, are of far greater permanent value whenever it is possible to preserve them thus, than when they are (sometimes unavoidably) dispersed, or even broken up to be incorporated with larger collections. The collection includes longer or shorter series of 654 species, more than 300 named varieties and aberrations, and 720 specimens of preserved larvæ. These are contained in forty-two cabinet drawers, and Mr. Browne has carefully noted the origin of every specimen according to Mr. Dobrée's note-books, and added short descriptions of a large number of aberrant specimens, named or otherwise. The work is of much importance to all students of the interesting group of moths of which it treats.

The Human Race: its Past, Present, and Probable Future. An essay by J. Samuelson. Pp. xii+192. (London: Swan Sonnenschein and Co., Ltd., 1910.) Price 3*s.* 6*d.* net.

IN part of this small volume is summarised the whole history of the human race—man's origin and material progress, the history of his vices and virtues, and of his mental, social, and political development. That such a summary must be very superficial is only to be expected, and the author claims very little for it, but hopes "that it will at least stimulate inquiry and serious study on the part of youths about entering life." Its chief fault appears to us to be that there is no clear distinction drawn between changes in man himself and changes in his surroundings. Thus, for example, under the heading "Man's Mental Progress" are catalogued a number of discoveries and inventions, such as the spectroscope and telephone, which are not evidence of mental progress at all if one takes the term to mean improvement of mental powers. It is also to be regretted that, although the author appears to be a believer in evolution, no mention is made of heredity as a factor possibly affecting the history of mankind.

E. H. J. S.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Heat developed during the Absorption of Electricity by Metals.

IN 1901 (O. W. Richardson, Camb. Phil. Proc., vol. xi., p. 286) one of the present writers showed that the phenomena attending the emission of negative electricity by hot metals could be explained on the assumption that the electrons which, on the electron theory of metallic conduction, move freely inside the metal attain sufficient kinetic energy at high temperatures to enable them to overcome the forces tending to keep them inside the surface and so escape. From the way in which the thermionic current varied with the temperature of the metal it was shown that the difference in the value of the potential energy of an electron when outside and when inside a metal could be calculated. Somewhat later (O. W. Richardson, Phil. Trans., A, vol. cci., p. 497) it was shown that the existence of this difference in the potential energies would involve a loss of thermal energy by the substance when the electrons were being given off, and it was pointed out that this effect would increase very rapidly with the temperature, so that at sufficiently high temperatures the loss of energy due to this cause would be greater than that arising from thermal radiation. An effect of this character has recently been discovered by Wehnelt and Jentzsch (*Ann. der Physik*, iv., vol. xxviii., p. 537).

Another consequence of the existence of this difference of potential energy is that when electrons possessing negligible kinetic energy pass into a metal an amount of heat should be liberated which is equal in magnitude to the difference in the potential energy for each electron multiplied by the number of electrons entering the metal. Experiments which have been carried out by the writers show that this effect exists, and is of the expected order of magnitude.

The method adopted was to cause the electrons emitted by two hot osmium filaments to flow on to a grid of fine platinum wire, which acted as a bolometer, and was placed in one arm of a double Wheatstone's bridge. The double bridge arrangement enabled the galvanometer to be balanced for the thermionic current into the bolometer in each experiment. The change in the resistance of the bolometer per unit thermionic current was measured when different voltages were maintained between it and the negative ends of the filaments.

In order to standardise the bolometer a known variation of current through it was produced, and the resulting change of resistance due to heating measured. By making use of this datum the energy received by the bolometer per unit thermionic current can be expressed in terms of the fall of potential which the electrons would have to undergo in order to produce the observed effect. The value thus obtained may be denoted by the "effect in volts."

When the effect in volts E is plotted as ordinate against the negative potential of the negative end of the filaments V as abscissa, the relation between them appears to be a linear one. The line, however, which is obtained does not intersect the axis of ordinates at $E=0$, but in the neighbourhood of $E=3$ volts, showing that when the electrons fall through no difference of potential due to the field they are still able to produce a heating effect equivalent to that due to the energy they would have received in falling through a difference of potential of about 3 volts. Inasmuch as Richardson and Brown (*Phil. Mag.* [6], vol. xvi., p. 353) have shown that the natural kinetic energy with which the thermions are emitted corresponds to only about 1/30 volt, the conclusion is inevitable that there is a liberation of potential energy when the electrons enter the metal comparable with that which would be acquired by falling through a difference of potential of about 3 volts.

Experiments have, so far, been made with applied potentials varying from $+2$ to -9 volts, the potential drop along the filaments due to the heating current varying from 3 to 3·7 volts. Changes are now being made in the experimental arrangements which, it is believed, will lead to greater accuracy of measurement. It seems likely that, owing to certain defects in the present apparatus, the values which have so far been obtained are somewhat too low.

O. W. RICHARDSON.
H. L. COOKE.

Palmer Physical Laboratory, Princeton University,
Princeton, N.J., December 21, 1909.

Malaria and Ancient Greece.

IN his scholarly "Malaria and Ancient Greece," reviewed in NATURE of December 16, 1909, p. 192, Mr. Jones has apparently overlooked what seems to be, though modified for dramatic purposes, a description of an acute attack of ague, *i.e.* that given by Sophocles of the sufferings of Philoctetes in his play known by that name. Here, just as he is about to accompany Neoptolemus to the ships, Philoctetes is seized with a sudden attack (line 730). He recognises the prodromal symptoms of what he describes to Neoptolemus as a recurrent attack of his malady (*ἥκει γὰρ αὕτη διὰ χρόνου*, line 758). The attack appears to be ushered in with pain or discomfort (line 730) and shivering (735). The symptoms become increasingly acute (*καί τι προσδοκῶ νέον*, 784) until they become almost unendurable (790). Soon, however, from previous experience, Philoctetes can foretell that the worst is over (808), and that the attack will pass away during the sleep which always supervenes. *λαμβάνει γὰρ οὖν ὕπνος μ', ὅταν περ τὸ κακὸν ἐξίῃ τόδε*, 766.

Later on, as he is falling asleep, Neoptolemus directs the attention of the Chorus to the profuse perspiration which bathes his body (823). The periodicity, suddenness, and ingravescence of the symptoms, the sleep and sweating followed by a passing feebleness on waking (880), present a clinical picture the vividness and truth of which are not surpassed in any literature. The congeries of symptoms in this description must be based upon actual experience of disease. It will, of course, be urged that Sophocles makes all the symptoms dependent upon the uncured wound in the heel caused by the snake-bite at the shrine of Chryse. Here there need be, however, no difficulty in the acceptance of the ague theory, for this would be in full accord with the accepted pathology of the period. The Greek physicians were probably well acquainted with the characteristic results of non-fatal snake-bite—the pain, sloughing with foul discharge, and delayed healing.

Without attempting to labour the point further, from a strictly clinical point of view the imposition of a malarial infection upon a chronic condition such as that described would, without doubt, give rise to periodic exacerbations of the inflammatory conditions. This is probably the explanation of the statement of Hippocrates quoted by Arndt (*cp.* Jebb, *Philoctetes*, p. 241) that the "ulcers become especially inflamed on these alternate days."

The *Philoctetes* was performed in 409 B.C., just when, according to Mr. Jones's theory, malaria was becoming widely disseminated through Greece, and nothing would be more natural than that Sophocles, in his wish to draw the sympathies of his audience to his long-suffering hero, should represent him as wracked with all the horrors of the new and strange disease, which appeared to lend themselves peculiarly to his purpose. There can scarcely be a sight more pitiable than that of a person in an acute paroxysm of malaria.

It is much to be regretted that the loss of their respective plays prevents a comparison with the manner in which Æschylus and Euripides treated the subject. That Sophocles had a keen clinical grasp of the salient features of disease is noticeable in his description of the Acute Delusional Insanity of Ajax—a description of a form of mental aberration which is extraordinarily true to nature, and one which from a clinical standpoint far surpasses the delineations of madness by Shakespeare, as might indeed be expected from a consideration of the relative positions of medicine as a science at the times of the respective poets.

GEORGE A. AUDEN.

Birmingham.

An Example of Spurious Correlation.

If I am not mistaken, the first method of forecasting the summer season proposed by Mr. A. B. MacDowall in NATURE of September 16, 1909 (vol. lxxxi., p. 335), is based upon a spurious correlation. If we take a series of departures from normal of a meteorological element and tabulate the sums of consecutive groups of thirty, there will always be a relationship between these sums, although the original departures may be entirely independent, and hence the relationship between the sums cannot be utilised for forecasting an individual term of the original series. That such sums of independent departures are not independent may be seen in the following way. If we denote the original independent departures by d_1, d_2, . . ., and the sum of thirty quantities beginning with d_p by s_p, the correlation coefficient between such quantities as s_p and s_{p+1}, as given by statistical methods, will be the mean value of a long series of products $s_p\, s_{p+1}$ divided by the product of the square roots of the mean values of s^2_p and of s^2_{p+1}. Now as d_p, d_q are independent the mean value of the product $d_p\, d_q$ will be zero; and it is easily seen that the correlation coefficient in question is the mean value of $(d^2_{p+1}+d^2_{p+2}+ \quad +d^2_{p+29})$ divided by the product of the square roots of the mean values of $(d^2_{p+} \ldots +d^2_{p+29})$ and of $(d^2_{p+1}+ \quad +d^2_{p+30})$; if we denote the mean value of d^2_q by m^2, this becomes $29m\,/30m^2$, or 29/30. Thus the thirty-year sums of independent annual departures will tend to vary closely together, and the dots in a diagram like that of p. 335 would tend to lie on a straight line.

The relationship actually found by Mr. MacDowall between the sums does not appear, therefore, to afford a satisfactory basis for a forecast. GILBERT T. WALKER.

India Meteorological Department, Simla,
December 16, 1909.

On Fluorescence Absorption.

It is desirable to direct attention to Prof. R. W. Wood's most important paper in the *Philosophical Magazine* for December, 1908, on a method of showing fluorescent absorption directly if it exists; but it seems certain that he has, at the end, drawn a conclusion from his experiments the very opposite, as I venture to think, to that to which they really lead. He compares the light apparently transmitted by a fluorescent body when fluorescence is, and is not, taking place, and finds that there is no difference in the resultant effect. This, I think, is as it should be; but the inference he draws is that there is no difference in the absorption. For my part I must admit that it only confirms my results published in the Philosophical Transactions, vol. cxci., A, 1898, that there is such an absorption; for if there were none such the light *apparently* transmitted would be less when the body is not fluorescing, owing to the fact that the fluorescent light would increase the *apparent* transmission, and a flickering should ensue; but Wood's experiment demonstrates that this is not so. The inference I should draw, then, is that during fluorescence there is an increased absorption of the light transmitted.

Prof. Wood appears to assume, moreover, that the resultant effect on the retina of two successive flashes is equal to the sum of the two acting simultaneously, which is not the case, since the successive flashes act merely as an intermittent single flash would do.

Nichols and Merritt, who have fully confirmed my results spectroscopically, have shown that the absorption effect diminishes as the intensity of the transmitted light increases, so that when the intensity of the transmitted light is large in comparison with that of the fluorescent light there is no effect at all, owing to the fact that this transmitted light itself is sufficiently intense to excite fluorescence, and there is therefore no change of state in the two cases.

If uranium glass is used for the absorption—it was with uranium glass that I observed the effect—the source of the transmitted light should also be uranium glass. I may add that the best results were obtained by using the light from the spark between cadmium electrodes for exciting fluorescence. With a suitable Leyden jar in the circuit, the illumination is sufficiently steady, and any errors in this respect can be detected by the null method I have described. J. BUTLER BURKE.

December 18, 1909.

Adsorption.

"THE above effects, however, become of consequence in those frequent cases in which a muddy liquid is only partially filtered through a dry filter in order that some analytical estimation may be made in a given volume of the filtrate. *The first drops of the filtrate must therefore be discarded.*" The above quotation is from Ostwald's "Foundations of Analytical Chemistry" (English translation), the italics being in the text. Ostwald makes this a purely theoretical deduction, but the practice of discarding first drops does not, I think, originate with him. Doubtless many analysts neglect the precaution, but many use it.

Some experimental work on adsorption which I am at present carrying on seems to point to the practice being quite uncalled for in at least the majority of cases. I am not yet ready to speak definitely, but it seems to be as unnecessary as it would be to reduce weighings to a vacuum standard in everyday analytical work. Ostwald's extreme positiveness, however, makes me wonder whether I have overlooked some serious fault in my experimental methods, and I should be much indebted to anyone who would point out to me any references in the literature which give an *experimental* justification of the practice. The absence of any library facilities in this place makes a systematic search of the literature impossible to me.

ALFRED TINGLE.

Imperial Chinese Pei Yang Mint, Tientsin,
December 8, 1909.

The Terminal Velocity of Fall of Small Spheres in Air.

At the Winnipeg meeting of the British Association Prof. Zeleny and Mr. McKeehan read a paper on the terminal velocities which they had found when Lycopodium and other small spores fall through air. The measured terminal velocities were only about half those calculated by Stokes's formula. The fall was steady, no Brownian motion or rotation being visible. The authors of the paper have since succeeded (see NATURE, December 9, 1909, p. 158) in making minute spheres of wax and mercury which do obey the theoretical law, but add that the reason for the deviations in the former cases is not clear.

May not the reason for these deviations be the roughness of the spore? The drops, through surface tension, are smooth and practically perfect spheres, whereas a spore of Lycopodium is very rough relative to its size. (Using a microscope objective with large aperture, and oblique illumination, Lycopodium spores of about 14 μ radius were seen to be coated with hair-like projections.) The spore would, from its roughness, leave a tail of small eddies behind it. The increased energy of this turbulence represents the increased resistance which the spore experiences on account of its roughness, as compared with that experienced by the smooth drop considered in the theoretical law, much as the speed of a ship is lessened when its bottom is foul.

As a suggested experimental test, an increase in the pressure of the air will not affect the viscosity, but will alter the energy in this tail of small eddies. So also would a moderate decrease in the pressure, while yet it would probably not bring the relative size of the spore and of the gaseous molecular free path too close for the theory to be applicable. Should this be the case, however, it would be shown by the appearance of Brownian motion. EDITH A. STONEY.

Positions of Birds' Nests in Hedges.

LIEUT.-COLONEL TULL WALSH's observations as to the positions of nests (NATURE, December 16) are interesting, as they tally with the aspect of arboreal cryptogams, as already noted by me. South-west winds depositing sulphurous and nitrous products to leeward of towns cause lichens and mosses to flourish best on the eastern side of trees and hedges; and, moreover, this is general, for winds bearing spores from the south-west continually play on the trunks and blow away spores as they settle. If it were not for a kind of capillary attraction or rotary motion drawing the spores round the trunk to leeward, or east or north-east, they would never germinate. So the eastern side is the most productive, though often the western aspect may exhibit a greater abundance of species, though less well developed, from the continuous play of spores—and rain—upon the trunk.

Of north and south positions the same may be said, *i.e.* the south is sheltered from fierce, cold north winds, yet open to warm, rain-depositing winds. Again, once established, cryptogams flourish on the southern aspect best owing to its sunny character. North winds blow when spores are not so abundant, and the same applies to boisterous east winds, though these are short-lived.

Apart from wind dispersal of spores, vegetative reproduction tends to favour the same situations, south or east, for south-west winds bring moisture, and, when not laden with poisonous substances, are beneficial; but long-continued wind tends to drive plants to the east side, and absence of sun from north to south.

The causes inducing birds to nest preferably on the eastern and southern sides of hedges (and trees, to some extent) are much the same, *i.e.* protection from wind and the greater safety of a leeward position and amount of sunlight; but in their case, also, there is light dispersal. There is a shadow on the leeward side of hedges for a great part of the day after the early dawn, and this enables birds safely to go in and out without being observed.

The western side presents fewer convenient nesting sites, the branches of hedges being generally bent over from west to east, as seen best on the west coast, affording a better arbour on the east. The south and east face early dawn longest, and this is the favourite season of the birds. At any rate, their song is richest between 4 and 8 a.m. The north and west are open to bright sun but during the *colder* part of the day.

As to the actual distribution of nests, the same positions noticed by Lieut.-Colonel Tull Walsh are favoured by birds in Leicestershire, Shropshire, Surrey, amongst other counties, and seem to be more or less general. The need for studying cryptogamic distribution in relation to wind in connection with the extinction of plants led me to formulate the conclusions noted. It is interesting to observe that they are directly analogous to the position of birds' nests in hedges. Hence the parallel drawn.

A. R. HORWOOD.

Leicester Corporation Museum, December 22.

Studies in Polychæt Larvæ.

MAY I make use of your columns to correct an error in my "Studies in Polychæt Larvæ" in a recent number of the *Q.J.M.S.*? The specimen there described as a young Odontosyllis sp. I have since found to be in reality a fully grown Exogone. I have been unable to identify it with any known species, but as dorsal natatory setæ are quite well known in specimens of Exogone of this size, the conclusions drawn from this specimen are of no value.

With regard to the last section of the same paper, it has lately come to my notice that de Saint-Joseph has shown Claparède and Mecznicow's so-called Spionid larva, in which there are no provisional setæ, to be the larva of the aberrant worm Saccocirrus, and not of one of the Spionidæ. There is, then, no known exception to the rule that free-swimming Spionid larvæ bear provisional setæ.

F. H. GRAVELY.

5 Silver Street, Wellingborough, December 27, 1909.

Cross-fertilisation of Sweet-peas.

I HAVE recently seen two further reiterations of the statement that the sweet-pea is invariably self-fertilised, a statement which I think is often based on an opinion of Charles Darwin's. It may therefore be worth while placing on record an observation made by me in 1907, when examining daily and closely a large quantity of sweet-peas. While *Apis mellifica* failed entirely to open the flower, it was done perpetually by *Megachile willughbiella*, and there was not the least doubt about the cross-fertilisation being effectively brought about by this bee. The point has probably been noted before, but it is worth recording once more in view of the repetition of statements as to the self-fertilisation of sweet-peas.

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A Supposed New Mineral.

WHEN we wrote recently (NATURE, October 28, 1909) about a supposed new mineral from Co. Antrim, we were led to believe that the specimen we had received was from the basalt—our information, in fact, was that "a very big pocket of it" had been found in that rock, but the exact locality could not be ascertained at that time, the finder having left home.

We now hear that this gentleman cannot remember where he got the specimen. It certainly cannot be traced to the basalt, and as its composition is unlike that of any known mineral, it seems highly probable that the substance is an artificial product.

RICHARD J. MOSS.
HENRY J. SEYMOUR.

Laboratory, Royal Dublin Society,
December 23, 1909.

THE HEART OF ANTARCTICA.[1]

IMMEDIATELY after the arrival of the British Antarctic Expedition of 1907–9 in New Zealand the attempt was made in NATURE (April 1, 1909, vol. lxxx., p. 130) to estimate its scientific results from the information received by cable. The full details now supplied show that the estimate then made in no way exaggerated the greatness of its achievements. The full story of the expedition, told in these most interesting and beautifully illustrated volumes, shows that its great success was due to careful and scientific foresight in equipment, to the determined and uttermost use of the equipment and staff, and to daring in the field, carried sometimes to the verge of recklessness, but saved from accidents by sound judgment and cool courage.

The main purpose of the expedition was to reach the South Pole, and as that object required an advance into the heart of Antarctica, no better route could have been selected. There can be little doubt that the expedition would have been completely successful and reached the Pole but for the accidents to the ponies. Four of them died in the winter quarters, one from eating some poisoned shavings, and three from eating sand—perhaps due to the craving of horses for salt, that may not have been adequately allowed for in their food. The most irreparable accident was the loss of the last pony during the southern sledge journey by its fall into a crevasse on the Beardmore Glacier. The sledge party was thus deprived of an important part of its reserve food, and the accident was especially annoying, as the pony was to have been killed that night. The horse meat was not a complete success, as it brought on dysentery. Sir Ernest Shackleton explains this somewhat unexpected result by the meat being poisoned by a toxin of exhaustion. As the symptoms of fatigue can be transmitted by inoculation from a tired to an untired dog, the suggestion sounds probable.

The work is prefaced by an admirable introduction by Dr. Mill on previous Antarctic work. The first volume describes the equipment, the vain attempt to land on the eastern side of the Great Ice Barrier, the establishment of headquarters on MacMurdo Sound, and the winter's work there. The motor car proved of great service around the station, but though it ran well on smooth sea ice, it would have been of no use on the soft surface of the Barrier.

The great sledge journey to the south was, therefore, dependent upon the ponies; and these did their work well. The sledging party consisted of Sir Ernest Shackleton, Adams, Wild, and Marshall, with four sledges, each hauled by a pony. The explorers made a quick journey southward until the mountain wall which forms the western boundary of the Ross Sea and of the Great Ice Barrier curved eastward and lay across the route to the Pole. The mountain scarp is breached by a valley occupied by the Beardmore Glacier, which offered a difficult route to the plateau, and up it the explorers forced their way. After many narrow escapes from crevasses, the expedition attained the plateau and marched southward across it until the exhaustion of their food compelled them to turn back at a point only ninety-three miles from the South Pole. No scientific advantage would have been gained by traversing the remaining distance, and, considering the small reserve supply of food, the risks that had been accepted were, if anything, unduly high.

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[1] "The Heart of the Antarctic. Being the Story of the British Antarctic Expedition, 1907–9." By Sir E. H. Shackleton, C.V.O. With an Introduction by Dr. Hugh Robert Mill. Vol. i., pp. xlviii+372; 132 plates. Vol. ii., pp. xvi+419; 141 plates, 3 maps. (London: W. Heinemann, 1909.) Price, 2 vols., 36*s.* net.

This magnificent sledge journey has practically demonstrated that the South Pole is on a high plateau, which is bounded to the north by a continuation of the mountain scarp of South Victoria Land, and that this scarp trends eastward towards Graham Land.

The second important achievement by the expedition was the daring sledge journey by Prof. David and Messrs. Mawson and Mackay to the South Magnetic Pole. This great feat was all the more remarkable as not one of the three members had any previous Arctic or Antarctic experience. Prof. David's party had to haul its own sledges, make double journeys over most of the way, and work on half rations almost from the first day. They successfully sledged along the coast of Victoria Land, and then up the Larsen Glacier and over the inland ice to the South Magnetic Pole. They ran great risks from crevasses, and had to incur the added danger of not being found by the *Nimrod* on their return to the coast. Had they been delayed a few days they must have missed the ship, and their only chance would then have been to wait until the sea again froze over and they could sledge back to winter quarters.

The scientific results of the expedition are unquestionably of the highest importance. It found that, as was suggested in NATURE in 1901, the mountains of South Victoria Land curve eastward, so that the South Pole stands on a high plateau, of which the scarp facing the Pacific trends towards Graham Land. The structure of the mountains of Graham Land and of South Victoria Land is very different; hence we must expect either a continuation of the fold line of Graham Land between the great scarp of Antarctica and the South Pacific coast, or else that the eastward extension of the fold line of Graham Land has foundered beneath the sea, leaving the coast of Antarctica along the South Pacific of the secondary Pacific type.

The scientific problems raised in the second volume are of wide interest; though only preliminary statements are given, they show the wide range and high quality of the work. The accounts are most definite in regard to geology and biology, and they include appendices on the meteorology, magnetic observations, aurora australis, and on tides and currents. The expedition was fortunate in having such an expert geological staff as Prof. David, of Sydney, Mr. Priestley, of Bristol, and Mr. Mawson, of Adelaide, of whom the last acted also as the physicist to the expedition. The biologist, Mr. James Murray, is a well-known specialist on the smaller animals most likely to live on an Antarctic land. Among the most remarkable of the geological results was Sir E. Shackleton's discovery of several seams of coal and coaly material, and of a band of limestone in the southern continuation of the Beacon Sandstones. He was fortunate in collecting the only recognisable fossil (other than radiolaria) hitherto found in this quadrant of Antarctica; it has been determined by Mr. E. J. Goddard, of Sydney, as a piece of coniferous wood of Upper Devonian or Carboniferous age; it furnishes the only direct evidence of the age of the sandstones that are so important in the geology of South Victoria Land.

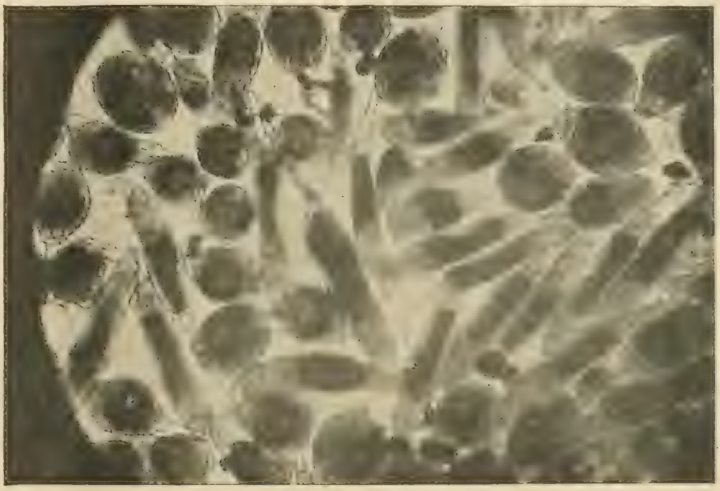
FIG. 1.—The Gregarious Rotifer, which forms blood-red patches in the lakes at Cape Royds. From "The Heart of the Antarctic."

Mr. Priestley's excursion to the mainland opposite the winter quarters also yielded interesting results, which greatly reduce the thickness previously assigned to the Beacon Sandstone, and throw doubt on its invasion by a younger granite. Prof. David determined the geological history of Mount Erebus, as well as obtained most valuable results as to the structure of South Victoria Land.

One of the most instructive of the geological results is Prof. David's description of the Nordenskjöld and Drygalski Glaciers, which continue out to sea as great ice capes for sixteen and thirty miles from the coast. These projections appear to be certainly floating, and, though fully exposed to the gales of this stormy sea, they have not been broken up into icebergs; moreover, solution by sea water appears to be very slow, as Prof. David describes the floating end of the Nordenskjöld Glacier as dwindling away from the failure of fresh supplies of ice from the snow-fields by which it was formerly fed. The Great Ice Barrier appears to be of quite a different origin. Shackleton records in his diary (vol. i., p. 293) that "The Barrier surface is still as level as a billiard table, with no sign of any undulation or rise." And with his keen geographical insight Shackleton discriminated (*e.g.* p. 305) between the Barrier ice and the glacier ice, which in places is thrust into it from the land.

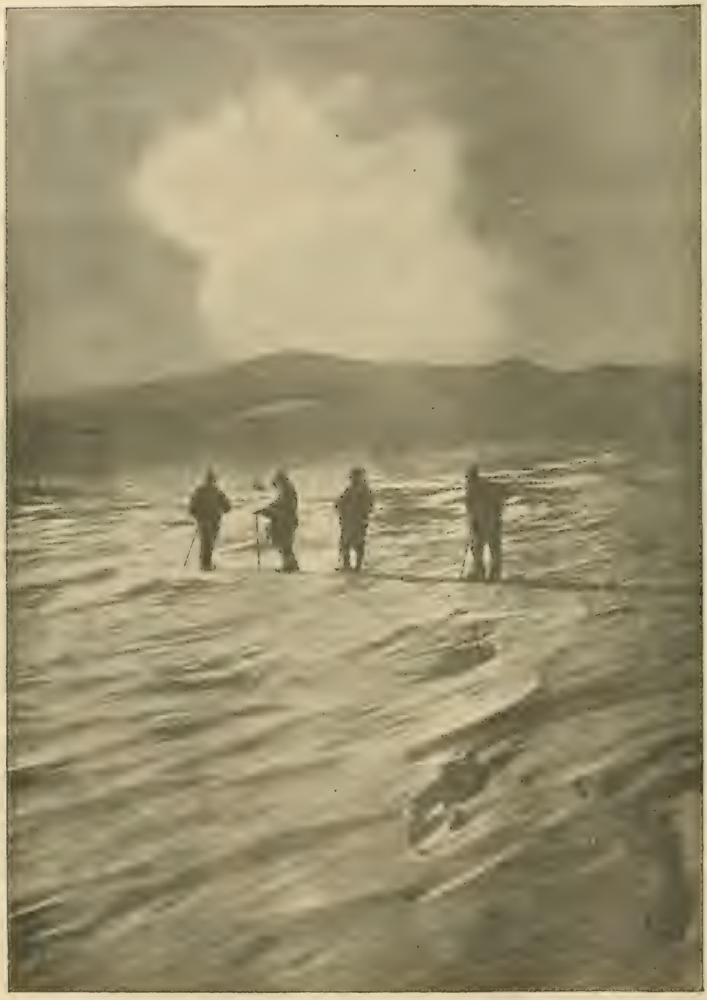

FIG. 2.—One thousand feet below the active cone of Erebus. From "The Heart of the Antarctic."

It would be difficult to explain the striking uniformity in level of the Barrier if it were land ice flowing northward, the conclusion adopted by the staff of the *Discovery* expedition. This view was rejected in NATURE in the reviews, both of Captain Scott's narrative and of the volume on the geological results of the *Discovery* expedition, in favour of the origin of the ice "by the accumulation of layers of snow upon the surface more quickly than the ice was dissolved by the sea beneath" (NATURE, 1906, vol. lxxiii., p. 300). This explanation was then attended by the difficulty that the snowfall was said to be too low. The evidence, however, of the photographs brought back by the *Discovery* seemed so convincing that the writer concluded that the snowfall would be found much larger than was reported. The new observations show that the snowfall at the winter quarters was equivalent to a rainfall of 9½ inches a year, and that on the Barrier the average for the past four years has been 7½ inches. This amount of snow seems adequate for the formation of the Barrier ice from snowfall, and this explanation of its origin is now fully confirmed by Prof. David.

The meteorological results are still indefinite, but further light on the hypothetical South Polar anticyclone may be expected from the full records. The narrative shows that there was a less constant blizzard from the south in the southernmost district than was inferred from the cable report. There was a north wind, for example, behind the party during its ascent of the Beardmore Glacier. Nevertheless, the direction of the ice ridges on the polar plateau shows that its prevalent wind is from the south. The evidence available suggests that, if the South Polar anticyclone exist, it is either less extensive than was thought, or its centre is in the area between the South Pole and the southern Atlantic.

The appendix on the zoological results gives many interesting particulars as to the habits of the penguins and seals. Mr. Murray is an expert on the rotifers and tardigrades, of which he found a rich fauna in lakelets near the winter quarters. They are only thawed occasionally in the summer, and live in ice through most of the year. They were subjected to various experiments to test their resistance to low temperatures and ultra-saline waters, and they triumphantly survived. Mr. Murray discusses the geographical relations of this fauna, and concludes from the poverty in species, and their wide distribution, that it is due to modern immigration. Mr. Murray collected many marine animals from what he describes as the living carpet covering the sea-floor in McMurdo Sound.

The lakes also contain a rich growth of fungus, which Prof. David describes as giving rise to beds of peat. It is therefore possible that coaly material may be formed in the Antarctic area even under existing conditions. The fossil conifer found by Shackleton shows that Antarctica once had a milder climate than at present, a fact already established by the work of Swedish expeditions, and only natural as a correlative of the warmer conditions that once prevailed in Greenland and Spitsbergen.

J. W. Gregory.

GAME PRESERVES IN BRITISH EAST AFRICA.[1]

Colonel Patterson is already well known to the British reading public by his remarkably interesting book on his destruction of the man-eating lions which infested the eastern section of the Uganda Railway during its construction and first years of activity. He returned to East Africa in 1907, but whether as a Government servant or as a private traveller is not clearly stated in the book under review (which it may at once be said is exceedingly interesting to a wide circle of readers—those who love thrilling adventures, those whose chief interest is in sport, and to students of the East African mammalia). Whether he was all the time or not on Government business, he had not been long back in East Africa before he was requested to undertake an important mission to the little-known north of the Protectorate across the Guaso Nyiro, there to report on the most suitable frontier to be fixed as the eastern limit of the great Northern Game Reserve.

Seeing the risky and important nature of this journey, the need to avoid any unnecessary responsibility and cause for anxiety, and, if need be, to travel light and with swiftness, it was (as the author half admits) unwise to have allowed two friends (an English sportsman and his wife) to accompany him into such a remote and possibly dangerous part. However, they went; the friend was killed by a revolver accident, and the author of the book was faced with the dilemma as to whether he should immediately escort the widow back to civilisation, some three hundred miles away, or complete his survey (another fifty miles) and then return. He very sensibly adopted the last course. It should be mentioned that the lady with whom circumstances obliged him to travel showed herself a brave woman and an excellent rifle shot. She faced elephants, lions, rhinoceroses and buffalo, sickness of herself and others, mutinous followers, with equal courage and coolness. But it is, of course, a commonplace by now to point out that in the hardships of exploration and the dangers of big-game shooting, British women, some Americans, and a few French and German women, are quite on a par with the men of their race.

One can admire their pluck, but at the same time regret that it should be thrown away on often unnecessary dangers in attacking wild animals far too interesting to be killed. But apparently the men and women of the Caucasian subspecies will not rest content until every big beast and every bird of remarkable plumage is exterminated.

Colonel Patterson does not tell us (so far as we can gather) what recommendation he made as to the definition of the eastern boundaries of this Northern Game Reserve; he hints, however, in one place, that its area is unwieldy (which is quite true), and that as it stands it is far too large to be properly supervised. The whole question, it is to be feared, is purely academic in the British Empire. Large or small as the game reserve may be, the native peasant or the nomad hunter *takes* leave, the Royal or distinguished visitor is *granted* leave, and somehow the shooting goes on. Abyssinians, Somalis, Arabs, and even Goanese traders, adventurers, or bandits, enter this Northern Game Reserve and defy the law to stop them or punish them, and it is said the Boer settlers of the western part of the Protectorate are doing the same.

Fig. 1.—Camels crossing the Kaisoot Desert. From "In the Grip of the Nyika."

The history of the East Africa Protectorate will, no doubt, be very like the history of Cape Colony and the Orange State: the big game will be nearly all killed out, not within the next ten, but certainly within the next fifty years. For it occupies land which in many parts is really well adapted for human occupation (with all the appliances we now possess for turning the tropics to account). The only way to preserve the game to a reasonable degree in selected parts of Africa will be to convince ourselves that these "useless" beasts *are* worth preserving for their beauty or their interest; secondly, to impress that principle in their childhood's education on the rising generation of the white race; and, thirdly, to spend time and money to impart this doctrine to the natives of Africa, making it well worth their while to cooperate with us.

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[1] "In the Grip of the Nyika: Further Adventures in British East Africa." By Lieut.-Col. J. H. Patterson, D.S.O. Pp. xv+389. (London: Macmillan and Co., Ltd., 1909.) Price 7s. 6d. net.

Of course the Northern Game Reserve is far too large. Colonel Patterson alludes to its history. It was jointly instituted by two commissioners of East Africa and Uganda—Sir Arthur Hardinge and the writer of this review—as a temporary means of arresting the devastations of Europeans, Somalis, Goanese, &c., until the question of game preservation could be more deliberately dealt with in legislation. The time has now come (since the entire reserve of 38,000 miles lies within the limits of the East Africa Protectorate) to cut up this area into (say) three "national parks" of, perhaps, five thousand square miles each, and provide each park with a sufficient staff of game wardens. The remainder of the country would then be allotted to the expansion of native tribes, or be prudently held in reserve for future foreign settlement, if at present without human inhabitants. Disappointing as this reduction might seem, it would be better for the preservation of rare animals to set aside three or four areas each about the size of Yorkshire, in which *no one*, millionaire or prince, soldier or civilian, was to be allowed to shoot, than to mark on the map a reserve as large as Scotland, Wales, and the Isle of Man put together, and to be quite unable to control within its limits either natives or Europeans.

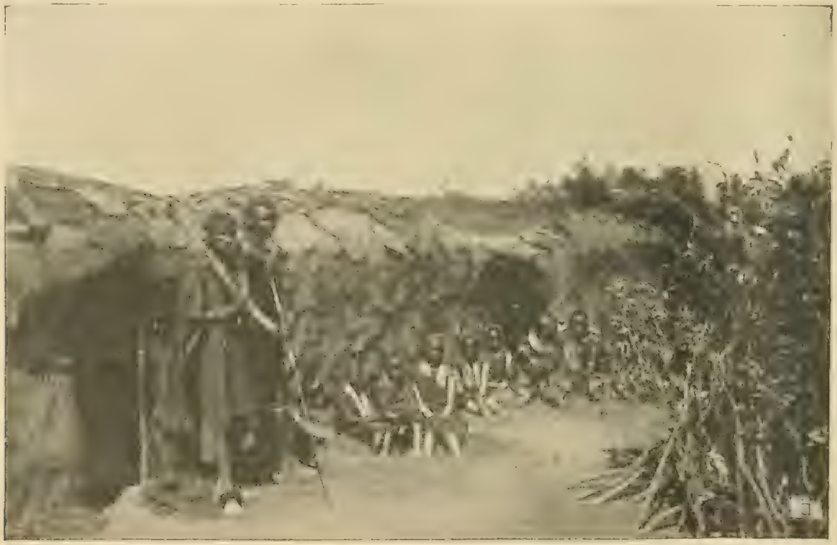

FIG. 2.—A Masai Manyatta. From "In the Grip of the Nyika."

These reserves might be specially selected for the preservation of the more important beasts; thus one could be marked out where rhinoceroses were most abundant; another to save and multiply the handsome Beisa oryx; a third for elephants, and a fourth for the giraffe; and the game wardens must be *civilians* and *biologists*, men of the stamp of the Indian forestry officers.

Colonel Patterson's book reveals the existence of very fine specimens of eland in British East Africa, on which the Government of that Protectorate should keep an eye. It gives new information about the course of the still mysterious Guaso Nyiro river, and contains interesting particulars concerning the Samburu negroids in the northern part of British East Africa. It suggests, indirectly, how much of interest to the student of Africa awaits discovery and explanation in the semi-desert regions that stretch between the Guaso Nyiro and the middle Juba.

H. H. JOHNSTON.

PROBLEMS OF SCIENCE TEACHING IN SCHOOLS.[1]

A DEFECT of intellectual character, national in its incidence, is revealed at conferences of teachers and in the reports issued by associations of schoolmasters and others concerned in educating English boys and girls. In this country the teacher, like the man in the street, is too narrowly "practical"; he regards the discussion of fundamental principles as unprofitable. Thus it is that we find details concerning exposition (*e.g.* of calorimetry) receiving the careful attention of the physics teachers of our leading schools before anyone has sought to answer the question, "Why teach physics?"

We admit that there is some virtue in the insularity of mind which produces this illogical treatment of class-room problems. The schoolmaster says that the aim of teaching chemistry is *to teach chemistry*, and concentrates his attention upon making each lesson effective, with the result that boys are made to do some definite work. Yet it can hardly be denied that neglect of the wider questions infallibly narrows the teacher's outlook, and that this narrowing sooner or later eliminates from his teaching all the vitalising enthusiasm for knowledge which a man who *believes* in his teaching can inspire in his boys. The best results are obtainable only when the teacher and the boys believe that the work which the class is doing is really worth while. How can a teacher hold such a belief steadfastly through the disillusions of experience unless he has thought out, to some extent, the why and whereunto of his work?

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[1] The American Federation of Teachers of the Mathematical and the Natural Sciences. Bulletin No. 2, November, 1909. (Secretary, C. R. Mann, University of Chicago.)

Another objection to the scrappy manner of approaching problems of class-room and laboratory is that such procedure is unscientific because unorganised. An analysis of the recommendations which have been published by societies of teachers in England will be fairly certain to reveal example after example of statements which you can neither accept nor deny until you have settled the *aim* which justifies inclusion of science in the curriculum. Nor is it to be imagined that a realisation of the educational functions of the various subjects is of import only to persons placed in authority—to the high priests of our educational hierarchy. Such a realisation (or the absence of it) affects every minute of every lesson given by the humblest practitioner of the teacher's craft. In all teaching, the objective dictates the method.

Granted that the fundamental problem of science teaching is the determination of the aim of such teaching, how far is it possible to generalise? How far will the aim depend upon the sex, range of age, previous preparation, and probable after-life of the majority of the pupils? It is easy to enunciate a few general truths, but it is clear that each school has its own special problem. Every subject worthy of a place in the school course does at least two things—(1) it enriches the mental content with valuable knowledge; (2) it develops mental power through the process of acquiring the knowledge. The former is too often under-rated by the schoolmaster, the latter by his lay critic, *e.g.* the business man. We must promote the fitness of the boy for his particular *rôle* in life, and at the same time give him as intelligent an understanding as possible of his fellow-men and their work. The boy should acquire some sense of his inheritance in the round world and all that therein is. Properly taught, science will have a humanistic value; the teachers of literary subjects must be made to feel, by the demonstrated effect of the science teaching in evolving many-sided interest in the boy, that they have not the sole title to "the humanities." But beyond such broad generalities there are no rules to be laid down, and the individual teacher must study his own case. In this task he might derive much assistance from debate with colleagues and in educational conferences.

Teachers in the United States have organised large federations of associations in order to discuss the broad problems of teaching. The concluding paper of a "Symposium on the Purpose and Organisation of Physics Teaching in Secondary Schools" appeared last March, and now we find in "Bulletin Number Two" papers on "The Problems of Science Teaching," written by President Ira Remsen (chemistry), Messrs. G. F. Stradling (physics), J. M. Coulter (botany), W. T. Campbell (mathematics), and N. M. Fenneman (physical geography). We abstract from the paper which deals with botanical instruction. The first problem, writes Prof. Coulter, is the prepared teacher, a problem not peculiar to botany, but peculiarly conspicuous. The prepared teacher means one who, in addition to good laboratory and field experience, has a clear conception of the purpose of botany in secondary schools, as distinct from its purpose in higher institutions. To inject into these schools miniature duplicates of college and university courses is to defeat their purpose. There is no ideal method of first attack; the most natural one is the one nearest to the pupils. It would be very unfortunate for any committee to assume to determine that some one method of approach is the best. A current problem is the place of the economic aspects of botany. The older educational theory emphasised mental discipline to the exclusion of useful things, so that sometimes no useful plants were included in the course. In these days there is a tendency to the other extreme, and it is proposed to substitute agriculture for botany—a short-sighted change, because the most practical thing in the world is the foundation of pure science upon which applied science rests. The fundamentals of botany can be obtained from useful plants; but there should never be a straining after such plants at the expense of a clear illustration of the principle to be established. Referring to the proposal to include botany in general biology, using plants and animals indiscriminately for giving knowledge of biological principles, the author finds that this method is inappropriate to immature students, as the perspective is far too large to be grasped by their limited experience; but he suggests that the question be settled in conference. Finally, Prof. Coulter asks for a clear statement of the real value of botany from the point of view of the pupil—a serious attempt to answer the honest question, "What is it good for?"

Our only comment is that the "prepared teacher" who has answered the last question for his own school is in a fair way to solve the other problems propounded. We welcome this series of papers, for unless the teachers of science study their work with scientific method, *quis custodiet?*

G. F. DANIELL.

MAGNETIC SURVEY OF SOUTH AFRICA.[1]

THE Cambridge University Press has published for the Royal Society a work giving an account of the results of the magnetic survey of South Africa carried out by Prof. Beattie, of Cape Town, with the aid of grants from the Royal Society, the British Association, and the Governments of the Crown Colonies in South Africa. The author, in the preface, acknowledges help from a number of scientific gentlemen in South Africa, and he has been fortunate in securing for the final presentation of the work the help and acute judgment of Dr. Charles Chree. The observations were made at some 400 stations in British South Africa, and extend over the period from 1898 to 1906, and the region is bounded roughly by latitudes 18° to 34° S., and by longitudes 20° to 36° E. The epoch to which the results have been reduced is July 1, 1903.

The amount of observational work required is very great and of a peculiarly monotonous type. The reduction of the results must have been a still more arduous task. It is difficult for anyone looking at the final results to realise the amount of sheer labour involved.

A work of this kind appeals in the main to professional magneticians, and for this reason the first part of chapter i. strikes us as a little out of place. It was hardly necessary to define the magnetic elements, but if the author thought it well to do so, he might have made them strictly scientific, instead of giving the kind of descriptive definitions which are suitable for a popular lecture. Similarly, a very "rough" method of finding declination is given. It looks trifling in a work of professional character.

Not the least difficulty in making a magnetic survey is the fact that the magnetic elements are constantly changing. The only satisfactory way of eliminating this trouble is by reference to a recording magnetic station within reasonable distance of the point at which the absolute observations are taken. Unfortunately, there is no such station in South Africa, and thus Prof. Beattie has been severely at a disadvantage. He has attempted by other means to eliminate the effects of periodic and secular change, but after giving an account of his attempts he concludes that the result is somewhat illusory, and probably most impartial readers will agree with him. This naturally sets a limit to the general accuracy, and unfortunately it is a case in which the excellent maxim of considering the pennies does not ensure that the pounds will behave with their reputed propriety.

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[1] Report of a Magnetic Survey of South Africa. By Prof. J. C. Beattie. Pp. x+235. (Cambridge: University Press, 1909.) Price 21*s.* net.

A statement of the reduced results and tables for the purpose of drawing charts of equal values of any element naturally occupies a considerable proportion of the book.

The problem of drawing equivalent curves from observations at discrete points calls for great experience and discrimination on the part of the operator. As regards the main features, no question can arise. The results agree well with the known geological formation, of which an excellent map is given. Moreover, the localisation of magnetic districts is fairly definite and must prove of value to geological and mining science; but some of the minor fluctuations may as well be due to local magnetic matter as to incidental error, from which, under the conditions, the observations cannot be quite free. The manner of presentation of the results will, we feel sure, meet with general approval. We trust that the author will not accuse us of unduly exceeding the limits of reasonable criticism if we suggest that the phrasing "with one instrument first, then with the other, and finally with the one again," is not the most elegant way of describing the operation of comparing instruments. Further, X, Y, Z, T so naturally represent the northerly, westerly, vertical components and total force that we deprecate the use of Z for total force and T for the northerly component.

In appendices which really occupy more than half the volume, a statement of the method of reduction and of the station observations is given. That the observations should occupy so large a space is only right, for we trust that future generations will desire to examine the record of this important work. In Appendix D the author gives a typical example of reduction of the determinations of horizontal force. We observe that Prof. Beattie estimates times in the vibration experiment to one-twentieth of a second. While several magneticians adopt this practice, we have some doubt whether, by counting chronometer ticks, one can always be certain of one-tenth of a second. Even with an electric chronograph it is not customary to estimate a single transit to nearer than one-tenth of a second.

In the determination of horizontal force a number of points arise. One's object being the value at a definite instant, we require a vibration and deflection experiment. In taking a vibration experiment, both before and after the deflection experiment, Prof. Beattie is well advised, but we are unable to follow the logic of his elaborate system of taking means. If the change in horizontal force during the experiments is linear and small, it will not make the least difference whether we take the average of the first and second vibration experiments or adopt Prof. Beattie's more elaborate procedure; while if the question enters on squares and non-linear change, we would point out that this has not been examined fully on the theoretical side. Again, we notice that the practice of reversing the magnet at a given distance was followed. A really better average is got by changing the distance on each reversal of the magnet according to the Kew practice. Whatever the elaborate way of combining the results may mean, it does not eliminate the frequent possibility of the value of H during the deflection experiment being different from the average value during the two vibration experiments, nor the fact that H may differ for the 30-cm. and the 40-cm. distances in the deflection experiment. These are, however, criticisms of detail, and do not affect the general accuracy of the final result, and the record of the first South African survey will remain a memorial to the industry and conscientious work of its director.

G. W. W.

M. BOUQUET DE LA GRYE.

AMONG French men of science, few have been more respected or have worked more indefatigably than M. Bouquet de la Grye, whose death, at the advanced age of eighty-two, was recently announced. His official work was more immediately connected with engineering and hydrography, but his scientific interests were wide, and he was equally well known as an astronomer and geodesist. As marking his qualities as a hydrographer, it is sufficient to recall that at an early age, shortly after leaving the École Polytechnique, he took a prominent part in charting the parts of the Mediterranean adjacent to the coasts of Italy and the Island of Elba. To estimate correctly the importance of this work, we must remember that in the early 'fifties, methods of surveying were not so systematised as they have since become, and mechanical routine had not displaced opportunities for original treatment. Subsequently, he was engaged in correcting the charts of the French Atlantic coast, and in the course of this work he assisted in improving the navigation of the River Loire and contributed greatly to the establishment of the successful port of Nantes. His work on river navigation, and his appreciation of the facilities for traffic which inland waterways offered, seem to have inspired him with the hope of converting Paris into a seaport, utilising the Seine, which he proposed to deepen for the purpose, and avoiding its irregular bends by the construction of canals. A system of docks and the whole machinery of a seaport were to be constructed at Saint Denis. Needless to say that this project, which demonstrates the extent of the imagination and enterprise of the regretted man of science, has not met with public favour. It seems to be the fate of canals either to be rendered useless by the increasing growth in the tonnage of steamers, or to involve such gigantic expenditure in construction that their commercial success is jeopardised at the outset.

In his astronomical work, M. Bouquet de la Grye will be remembered in connection with his loyal and long continued efforts to render the observations of the transit of Venus available for the determination of the solar parallax. In 1874, and again in 1882, he took active part in the preparations and in the actual observations, on the first occasion visiting Campbell Island, and on the second, Mexico. This method of determining the sun's distance may now be discredited. Improved technique and greater knowledge have permitted the use of methods of greater accuracy, providing results less difficult of interpretation; but it would be ungenerous to undervalue the devotion of astronomers of a past generation, who have been actuated by a sincere desire to benefit science and have exhibited both ingenuity and energy in the pursuit. It would be scarcely too much to say that for the last thirty years this subject occupied the attention of the deceased astronomer. The care and elaboration M. de la Grye bestowed on the reduction of the observations, sometimes devising ingenious experiments to remove photographic difficulties, at others undertaking new determinations of longitude in order to improve the data, are beyond all praise.

M. de la Grye's attention to geodesy supplied him with another outlet to his energy, and perhaps a relaxation. As a member of the Bureau des Longitudes, he interested himself in all questions which involved the figure of the earth, tidal movements, the variation of gravity or of latitude. He was a regular attendant at all geodetic congresses, reporting their proceedings and upholding their objects. The proposed scheme for the re-measurement of an arc of meridian in Peru had his hearty support. In the details he took the greatest interest, and his suggestions were appreciated by the commission. The encouraging support he was ever ready to extend to others, and his long experience, always at the command of those who sought his counsel, will be long missed by his colleagues, who well know how irreparable is their loss.

PROF. J. S. H. PELLAT.

It is with deep regret that we see the announcement of the death, after a very short illness, of M. Pellat, professor of physics at the Sorbonne (Paris). Joseph Solange Henry Pellat was born at Grenoble on July 27, 1850, and he died on the December 18 last. After leaving the École normale supérieure, he started work as meteorologist in the Paris Observatory. His stay there was not long, however, for he was soon appointed as professor in the Collège Rollin, and then at the Lycée Louis-le-Grand. In 1885 he was appointed a lecturer in the faculty of science at the Sorbonne, and was ultimately given a chair, which was created specially for him. He occupied many distinguished positions. He was for many years general secretary of the French Physical Society, and also occupied the presidential chair. He was vice-president in 1896 of the Société des Électriciens, and was president of the same society at the time of his death.

Prof. Pellat was one of a brilliant group of pupils of Prof. Jamin, whose laboratory at the Seine was a focus for physical studies. His scientific work covers nearly the whole range of physics. Of practical importance we may single out his construction of an electrodynamometer, in which the force is measured by which one coil is pulled inside another when a current flows through each. Measurements of the electrochemical equivalent of silver and experiments on the cadmium cell fall within the same category. It was, however, for questions having a theoretical bearing that he had the greatest interest. Some of his early work consisted in measuring the differences of potential of contact between two metals; and throughout his life, in common with practically all French physicists, he adhered to the views then held as to the existence and origin of these potential-differences. In a paper in the *Journal de Physique* for March, 1908, he combated the theory of Nernst in regard to the performance of a voltaic cell, and considered that his experiments proved that a metal immersed in a solution of one of its salts is sensibly at the same potential as the latter, at any rate when the solution is not too dilute.

Prof. Pellat was greatly interested in the properties of dielectrics; he constructed apparatus for measuring dielectric constants, and also (in 1899) for measuring their rate of change with temperature. The latter data were required to illustrate the application of a theorem deduced by him thermodynamically, according to which the increase of the energy of a condenser on being charged is only partly represented in general by the electrical energy, an intake (positive or negative) of heat occurring at the same time whenever the dielectric constant varies with temperature. In 1895 he promulgated a new method of dealing with electrostatic phenomena in the general case of heterogeneous dielectrics, in which Coulomb's law is dispensed with, and use is made of three experimental principles in conjunction with the two laws of thermodynamics. In an early paper on the influence of a metal on the nature of the surface of another metal placed a small distance away from it, he anticipated one of the modern phenomena of rays by showing that lead emits something capable of affecting a neighbouring photographic plate in the dark.

Of his devotion, zeal, and enthusiasm, M. Bouty speaks in the funeral oration (*Revue scientifique* for January 1), from which we have gleaned many of the above facts. He lived as in a beautiful dream. The taste for experimenting he had contracted as a youth. His experimental ingenuity was never at fault. He had furnished his laboratory with apparatus of his own invention. His lectures swarmed with original experiments. "Pellat had inherited a name rightly celebrated in juridical science. He transmits it to his widow and children shining with an added light."

DUKE KARL THEODORE OF BAVARIA.

The subjoined extract from the official gazette of the Principality of Monaco, referring to the death of Duke Karl Theodore of Bavaria, is worthy of being put on record as an appreciation of one great personage of high rank by another, and an acknowledgment that the nobility of station which commands the greatest respect is that which carries with it personal service to the community.

> Son Altesse Royale Charles-Théodore, Duc en Bavière, qui vient de mourir dans Sa résidence de Bad Kreuth, était le beau-père de Son Altesse le Duc d'Urach et Sa disparition atteint profondément le Prince Albert dans Ses affections les plus chères.
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> L'alliance entre la Famille des Ducs en Bavière et celle des Princes de Monaco n'avait pas, seule, rapproché les deux Princes; il existait aussi entre Eux une sympathie étroite basée sur la communauté de Leurs goûts pour le travail scientifique et le progrès des idées.
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> Le Duc Charles-Théodore, après avoir fait de brillantes études médicales, S'était spécialisé dans l'oculistique et pratiqua avec une habileté qui Lui attira une clientèle considérable: non pas celle qui apporte à l'opérateur une fortune, mais celle qui, au contraire, sort de chez lui moins pauvre qu'elle n'y était entrée.
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> Charles-Théodore fonda des cliniques, et ce Prince qui, dès sa jeunesse, avait senti qu'une couronne royale impose avant tout la pratique du bien, y fit des opérations très nombreuses. Dans cette tâche que Sa haute intelligence se donnait, il était secondé par Sa femme dont le cœur formait le digne pendant du Sien. Et le couple exemplaire vivait ainsi depuis trente-quatre ans sans être séparé un seul jour, si ce n'est quand l'Empereur Guillaume, blessé à l'œil, demanda les soins du Duc. Sa résidence de Kreuth, située au milieu des Alpes Bavaroises, loin des élégances mondaines, devenait vers le mois d'octobre le lieu de réunion d'une nombreuse famille que plusieurs amis, des confrères ou des professeurs, rejoignaient toujours avec joie. Alors se succédaient les chasses au cerf ou au chamois, celles qui se font dans les conditions vigoureuses, séduisantes pour des chasseurs de race: et le Prince Albert y trouvait régulièrement, depuis seize ans, la compensation de Sa vie laborieuse.
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> Il faut pleurer avec tout son cœur la disparition du

Duc Charles-Théodore, car Son existence était une leçon pour les hommes d'un rang élevé qui se contentent de vivre et de jouir; elle en était une également pour les humbles en leur apprenant de quelle façon il faut comprendre la vraie fraternité. Mais elle enseignait aussi à la jeunesse moderne, si rarement soucieuse de sa propre dignité, comment on traverse la vie dans toute la fière simplicité qui ne veut rien devoir à personne.

Et pour terminer cette existence admirable, le Duc Charles-Théodore, par l'expression formelle d'une dernière volonté, a maintenu jusqu'à l'ensevelissement de Sa dépouille, la simplicité de toute Sa vie: le concours des personnalités impériales et royales déjà accourues à Munich, celui de l'armée auquel Sa qualité royale lui donnait droit, celui des municipalités de la Bavière où sans doute il n'existe pas un village qui ne Lui ait envoyé des malades, celui de six mille opérés qui Lui doivent la vue, toutes les manifestations capables de flatter la vanité humaine furent écartées doucement; et jeudi dernier Son cercueil descendit, en présence de la famille seule, dans le caveau princier.

Cependant jamais funérailles ne furent plus grandioses, car tout un peuple était consterné devant la perte irréparable qu'il venait de faire.

NOTES.

We learn from the *Times* of January 3 that the will of the late Dr. Ludwig Mond directs his trustees, on the death of Mrs. Mond, to set aside two sums of 50,000*l.* each, free of duty, one to be payable to the Royal Society and the other to the University of Heidelberg. The will provides that the income of the 50,000*l.* bequeathed to the Royal Society "is to be employed in the endowment of research in natural science, more particularly, but not exclusively, in chemistry and physics, by providing rewards for new discoveries and pecuniary assistance (including scholarships) to persons pursuing scientific investigations, and in supplying apparatus and appliances for laboratories and observatories, and, so far as consistent with the Mortmain and Charitable Uses Act, 1888, or other similar provisions, in improving existing or in erecting new laboratories and observatories, and in such other manner as the Royal Society shall decide to be best calculated to promote scientific research, and also in providing, so far and in such amounts as the council of the Royal Society shall from time to time determine, for the publication and circulation of the reports and papers communicated to the said society, and for the preparation and publication of catalogues and indexes of scientific literature which the Royal Society may have undertaken or may in future undertake." Similar conditions govern the bequest to the University of Heidelberg. Dr. Mond also left three sums, each of 20,000*l.*, one for the authorities of the Akademie der bildenden Kunste at Munich, to be applied for the promotion of the arts of sculpture and painting; a second for providing pensions or occasional pecuniary assistance to aged or disabled workmen of Messrs. Brunner, Mond and Co., Ltd., or their successors, in the works at Northwich, Sandbach, and elsewhere; the third for the municipal authorities of Cassel.

Sir James Dewar, F.R.S., has been elected a foreign member of the Reale Accademia dei Lincei (Academy of Sciences) of Rome, in the section of physical, mathematical, and natural sciences. The King of Italy has signified his approval of this election.

M. Émile Picard, vice-president of the Paris Academy of Sciences, has been elected president for 1910, and is succeeded by M. Armand Gautier as vice-president.

The death is announced of Mr. W. Earl Hodgson, author of books on "Trout-fishing," "Salmon-fishing," and other works on fishing and popular natural history.

We notice with regret the death, on January 1, of Sir Edward L. Williams, in his eighty-second year. Sir Edward Williams was well known as the designer of the Manchester Ship Canal, which took twelve years to construct. He acted as chief engineer during the work of construction and on the completion of the canal in 1894 was knighted by Queen Victoria.

The annual general meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, Westminster, on Tuesday and Wednesday, January 18 and 19. The new president of the institute, Sir Gerald Muntz, Bart., will deliver his presidential address on the former day.

It was announced by the president of the Chemical Society at the last meeting that in view of the completion of fifty years' fellowship by the past presidents Sir Henry Roscoe, Sir William Crookes, Dr. Hugo Müller, and Dr. A. Vernon Harcourt, the council has resolved to entertain these fellows as guests of the society at a dinner to be held some time at the end of May or beginning of June.

The following appointments have been made to the Indian Agricultural Service:—imperial agricultural bacteriologist, Mr. C. M. Hutchinson; supernumerary mycologist, Mr. F. J. F. Shaw; supernumerary agriculturist, Mr. G. R. Hilson. The two posts of assistant superintendent recently vacant in the natural history section of the Indian Museum, Calcutta, have been filled by the selection of Mr. Stanley W. Kemp and Mr. F. H. Gravely.

We offer our congratulations to the *Chemical News*, which has just completed the fiftieth year of its existence and its hundredth volume. The Chemists' Club of New York and the American Chemical Society have sent Sir William Crookes messages of congratulation on the jubilee anniversary of his editorship of the journal, and the former institution has elected him an honorary member in recognition of his services to the science of chemistry.

The Geneva correspondent of the *Times* states that the Swiss Federal Government has decided to send a scientific expedition into the unexplored parts of Bolivia under the leadership of Prof. O. Fuhrmann, of the University of Neuchâtel. The explorers will leave Switzerland for South America on July 1, and their object will be to study the fauna, flora, and climate of the country. It is stated that several English and American men of science are to join the expedition at their expense.

On Tuesday, January 18, Prof. W. A. Herdman, F.R.S., will commence a course of three lectures at the Royal Institution on "The Cultivation of the Sea," and on Thursday, January 20, the Rev. C. H. W. Johns will deliver the first of two lectures on "Assyriology." The Friday evening discourse on January 21 will be delivered by Sir James Dewar, F.R.S., on "Light Reactions at Low Temperatures," and on February 4 by Prof. W. Bateson, F.R.S., on "The Heredity of Sex."

The death is announced, in his sixty-eighth year, of Dr. Charles B. Dudley. For a short time after his graduation at Yale he was an assistant in the department of physics at the University of Pennsylvania. Since 1875 he had been the chief chemist to the Pennsylvania Railroad Company, in which capacity he made important investigations relating to the composition of steel rails and of the lubricating oils used on railways. He was president of the American Chemical Society from 1896 to 1898. From 1902 to 1908 he was president of the American Society for

Testing Materials, and was recently elected president of the international society of a similar name.

THROUGH the kindness of Mr. and Mrs. Wickham Boynton, the collection of birds formed by the late Sir Henry Boynton, which for many years has been exhibited in the large room at Burton Agnes Hall, has been placed in the Municipal Museum at Hull. As all ornithologists are aware, Sir Henry's collection of birds, principally obtained by his own gun, was one of unusual interest and importance, and contains many great rarities. There are above 200 cases in all, and besides being valuable by reason of the scarcity of the specimens, the collection is interesting from the fact that in many cases both sexes of birds are represented, and in some instances there are also the young. Each case has been exceedingly well set up, and the whole forms a collection such as is rarely seen together. In addition to this, the Hull Museum has also recently acquired the collection of birds (about seventy cases) formed by Mr. Riley Fortune. This collection consists principally of Yorkshire specimens, and fortunately serves well to fill in the gaps in Sir Henry Boynton's collection. These, together with the Pease collection already in the museum, will enable the authorities at Hull to have a display of birds such as will be difficult to surpass in any northern museum.

THE President of the Local Government Board has appointed Dr. Eastwood, one of the pathologists of the Royal Commission on Tuberculosis, an additional medical inspector of the Board, with the special view of his undertaking pathological investigations. Provision also has been made for the necessary assistance and laboratories. The immediate object will be to apply to public health work the important results obtained by the Royal Commission on Tuberculosis, and thereby to ensure the freedom of important foods from the infection of this disease. It is intended also to investigate the similar problems which are constantly arising in connection with other infectious diseases. These investigations will be concerned chiefly with current doubtful points in regard to disease. The new work thus inaugurated by Mr. Burns will include inquiry as to the pathological methods of diagnosis of disease already utilised in the public health work of many sanitary authorities. It is expected that by interchange of information good work will be encouraged and extended, and that coordination and standardisation of the bacteriological methods of diagnosis of disease will be secured.

THE weekly returns of the Registrar-General show that in 1909, taking the returns for the fifty-two weeks ending with Christmas Day, the total deaths in London were 70,988. This is 3883 fewer deaths than the average for the previous five years, but it is 2353 more than in 1908, which, so far, is the healthiest year on record; the year which has just closed is, however, the second healthiest on record. The deaths in London for the respective quarters were 23,761, 16,917, 13,727, and 16,583; the rates per annum for every 1000 persons living were, for the respective quarters, 19·7, 14·0, 11·4, and 13·8. For the urban districts represented by the seventy-six great towns of England and Wales, the death-rates for the several quarters were 18·8, 14·5, 11·9, and 14·1.

WE have received a copy of a paper by Messrs. H. B. Torrey and F. L. Kleeberger, issued in the zoological series of the University of California Publications, on three new species of the actinarian genus Cerianthus from southern California.

WE have to acknowledge the receipt of a copy of the report of the Clifton College Scientific Society for 1908–9, this being the first printed report issued by that body for the last two-and-twenty years. The resumption of the issue will, it is hoped, enable members to keep more readily in touch with the work of sections other than those in which they are specially interested.

To the first part of *Sitzungsberichte der Niederrhein. Ges. f. Natur- und Heilkunde in Bonn* for 1909, Prof. G. Steinmann contributes an illustrated paper on the problem of ammonite-phylogeny, as exemplified, in this instance, by the genus Heterotissotia. It is concluded that, in place of being a member of the "Circumnodosi" group, Heterotissotia is really related to the Triassic Ceratites, of which it is to be regarded as the Cretaceous descendant. Accordingly, the original view of von Buchs as to the existence of Cretaceous as well as Triassic Ceratites is maintained by the author to be valid.

IN *Prometheus* of December 8, 1909, Drs. P. and E. von Hass, in the course of an article on the origin of the upright posture in man, assert that the ancestors of the human race used their canines for tearing the hide and flesh of the animals on which they fed (how these animals were killed is not explained), but that when they learnt to employ mussel-shells or flint-flakes for this purpose, their tusks, as being no longer necessary, rapidly degenerated. On the other hand, in a recent article in the *Daily Telegraph*, Sir E. R. Lankester has expressly stated that ancestral man never used his tusks for rending flesh. Whom are we to believe?

IN the issue of the *Yorkshire Weekly Post* for December 18, 1909, the natural history correspondent refers again to the killing of birds for the sake of ascertaining whether they have been ringed, quoting as instances a heron shot in Cheshire and a black-headed gull in Lancashire. The heron, he remarks, is protected in Cheshire, as in most other counties, so that the slaughter was illegal as well as unnecessary. In the case of a robin ringed at Glasgow, and picked up dead at the same place a few months later, he asks if there is any use in the ringing of such birds.

FROM the evidence of actual specimens and information obtained by Mr. Rothschild from his agents in California, Mr. Lydekker announces in the *Field* of December 25, 1909, that the so-called Californian elephant-seal to which Gill applied the name *Macrorhinus angustirostris* appears to be identical with *M. leoninus*, as typified by the specimens obtained by Lord Anson on Juan Fernandez, and named by Linnæus. The seals formerly inhabiting Guadalupe Island and the Californian coast are stated to migrate southwards after the breeding-season, and probably cross the equator. *M. leoninus* is characterised by the comparatively long snout of the old bulls, whereas in the Falkland, Crozet, and Macquarie sea-elephants, hitherto identified with *leoninus*, this appendage is shorter. These southern sea-elephants should be known as *Macrorhinus falclandicus* or *patagonicus*, unless the earlier Morunga, or its original and still more barbarous form Mirounga, be preferred.

THE vascular anatomy of mammals forms the subject of the two articles in the November (1909) issue of the *Anatomical Record*, Messrs. Schulte and Tilney discussing in the first the means by which the venous blood is returned to the heart, with especial reference to the iliac veins, while in the second Mr. C. B. Coulter describes the early stages in the development of the aortic arches in the cat, more particularly with regard to the existence of a fifth arch.

The existence in mammals of such a fifth arch, lying between the seismic and pulmonic arches, has recently formed the subject of several papers. This fifth arch appears to be a vessel rising from the aortic bulb and discharging into the pulmonic arch near its junction with the dorsal aorta. It attains fullest development in man and the mole, in both of which it is generally complete, but in the cat and the pig the full arch is rarely formed, while in the rabbit its condition is still more rudimentary.

A LARGE portion of vol. iii., part ii., of the Transactions of the Natural History Society of Northumberland, Durham, and Newcastle is taken up by papers on polypod Arthropoda, Canon Norman and Prof. Brady furnishing a synopsis of the local crustaceans, while Dr. A. R. Jackson comments on rare arachnids obtained in 1908, and the Rev. J. E. Hull contributes notes on spiders. Special interest attaches, however, to the description, by Mr. E. L. Gill, of a new Carboniferous arachnid from the Tyne Valley. This valuable specimen, which was obtained from the Coal-measures of Crawcrook, is evidently related to *Anthracosiro woodwardi*; the two forms agreeing in the general structure of the abdominal region. Whereas, however, the typical species has limbs of a normal type, those of the Crawcrook specimen are curiously expanded and flattened—so much so, indeed, that, unless this peculiar contour admits of some other explanation, it is evident that we have to do with a new species. It has accordingly been named *Anthracosiro latipes*, with the proviso that it may eventually be found advisable to change the generic title.

WRITING in the December (1909) number of the *Zoologist*, Mr. H. St. J. K. Donisthorpe claims to be the fourth naturalist who has witnessed in this country a slave-raid on the part of a colony of *Formica sanguinea*. The incident occurred at Bewdley, and the colony raided belonged to *F. fusca*. At the nest of the latter, the narrator states that "Many workers [of *sanguinea*], laden with pupæ, were streaming off in the direction of their home. . . . Others were attacking and killing solitary *fusca* workers. Several *fusca* workers were observed up the grass-stems, &c., holding pupæ, and endeavouring to escape from the slave-raiders. I watched these proceedings for a considerable time, and accompanied some of the ants with pupæ back to their nest, quite a distance off, though they covered the ground very quickly." In the same nest Mr. Donisthorpe took two "gyandromorph" *sanguiniae*, the one being, both in colour and structure, male on the right side and worker on the left, and the other male on the left and female on the right. Only two other specimens of such abnormal ants, neither referable to *sanguinea*, appear to have been previously observed in Great Britain.

As a large portion of the December (1909) issue of the *Journal of Economic Biology* is taken up by a list of literature and the proceedings of the Association of Economic Biologists, the articles are reduced to two. One of these, by Mr. S. A. Neave, who has recently returned from a prolonged tour in northern Rhodesia, Katanga, and the Congo Free State, relates to the distribution of the species of tsetse known as *Glossina palpalis*. The author remarks that the great Congo-Zambezi watershed forms a delimitation between two quite distinct faunas. On descending from this plateau into the Zambezi basin a fauna of the southern type is encountered, whereas at the same elevation on the Congo declivity the area of the western tropical fauna is entered. Now, so far as is known, *G. palpalis* occurs only on the Congo side, and its distribution coincides with that of the tropical fauna generally. Further, the extent of the range of the species within the tropical area is dependent upon station, the insect first meeting the traveller as he descends from the plateau in the well-wooded, damp gorges cut by the rivers and streams.

CIRCULAR No. 112 of the Bureau of Entomology of the United States describes very fully the Mediterranean flour-moth, and the damage and loss it causes to the milling industry. The pest was first noticed in 1892 infesting several Californian flour-mills, and since then it has gradually spread until at the present day it occurs in practically all the principal milling centres and in most of the States. On attaining full growth the caterpillar forms a new web, which becomes a cocoon wherein it undergoes transformation to pupa, and it is in this stage that the insect does most damage. The infested flour becomes caked, clogging the machinery and necessitating frequent and prolonged stoppage resulting in some cases in the loss of thousands of dollars. The remedy suggested is treatment with hydrocyanic acid; the methods of carrying out this rather delicate and dangerous fumigation, and the subsequent cleaning of the mill, are fully given.

THE Imperial Department of the West Indies has issued a pamphlet on the grafting of cacao, by Mr. Joseph Jones, curator of the Botanic Station, Dominica. It is shown that propagation by grafting gives better results than propagation by seed, inasmuch as the desirable characters of any particular tree, such as character of bean, prolific bearing, early bearing, and resistance to disease, &c., can be reproduced with tolerable certainty. Indeed, in no other way can the planter ensure absolute uniformity of bean, one of the most important features in the improvement of the quality of the crop. Grafted trees always develop into a low, spreading form, and this is of special advantage in picking the pods and also in affording protection from the wind. Full instructions for grafting are given, and the process is shown to be neither difficult nor expensive. Another pamphlet explains how to erect and work cotton gins, and is intended for workmen in regular charge of ginneries and for those who have to erect gins without any previous experience with this class of machinery.

THE "cotton-boll weevil"—a beetle of the genus Anthonomus, to which our own "apple-blossom weevil" belongs—causes in the United States an annual loss estimated at 25 millions of dollars. A vast economic literature has grown up around this insect, the latest contribution being an exhaustive account, by W. E. Hinds and W. W. Yothers, of its methods of hibernation (Entom. Bull., No. 77, U.S. Dept. Agric., 1909). The species is carried over the winter by adult beetles sheltering in various situations—many in old bolls that remain on the cotton-stalks. Only a small proportion of the individuals that commence to hibernate survive until the spring, so that the wintering period affords the most vulnerable stage in the insect's life-history, and detailed information respecting it cannot fail to be of value to the planters who seek some practicable means for destroying the weevils.

THE Year-book of the United States Department of Agriculture for 1908 contains some interesting short articles on the economic importance of vertebrates, written by naturalists attached to the Biological Survey. Mr. F. E. L. Beal discusses the relations between birds and insects, and argues that insectivorous birds are beneficial even though they destroy a large number of predaceous and parasitic insects, since the vegetable-eating insects that are present in any year in abnormally large numbers must form the larger proportion of the birds' food. Mr. A. K. Fisher writes on the economic value of predaceous birds and mammals. He believes that coyotes, foxes, weasels, and skunks are, on the whole, beneficial, and that the most dangerous enemies to poultry are domestic cats. Mr. D. E. Lantz describes the various poisons used for destroying noxious mammals such as wolves, gophers, and prairie marmots, and recommends strychnia-sulphate for general use. This poison is also advocated for campaigns on a large scale against voles by Mr. S. E. Piper, who contributes a paper on "mouse plagues," voles being usually known as "meadow-mice" or "short-tailed field-mice" by American farmers and naturalists.

THE Indian peasant, says the *Pioneer Mail*, usually looks with suspicion upon any scientific innovation which the Government may introduce for his benefit, and it speaks much for the efficacy of the expedient if it eventually overcomes his stubborn prejudices. Such success has attended the inoculation of cattle with rinderpest anti-serum prepared at the bacteriological laboratory of the Civil Veterinary Department. At first great opposition was experienced to the use of the serum, but since it has curtailed outbreaks of a malady which probably creates more havoc than any other cattle disease in India, and has prevented heavy mortality amongst animals, it has been much in demand, and it is now common for cattle owners in infected localities to pay for inoculators to be sent. It is expected that the demand for the serum will increase each year, and the Ceylon Government and many native States desire to be provided with it. The supply is, however, limited. During the year 1908–9 every endeavour was made at the bacteriological laboratory to prepare as large an amount as possible, but about eighty thousand more doses were required than were manufactured.

THE Selborne Society has just issued a new illustrated leaflet entitled "How to Attract Wild Birds." It is a reprint of an article written by the honorary secretary, Mr. Wilfred Mark Webb, for the *Country Home*, and deals with the methods employed in the Brent Valley Bird Sanctuary. A number of photographs which have been used to embellish it were taken in the Bird Sanctuary, and show the construction of the nesting-boxes, the ways of fixing them, the heights at which they should be placed, as well as the open trays which have also been successfully introduced.

IN *Travel and Exploration* for January Mr. P. L. Faulkner gives an account of the Khasia Hills, "a little-known district of the Indian Empire." His description is popular and interesting, but it is curious that he seems to be unacquainted with the valuable official monograph on the Khasi tribe by Major P. R. Gurdon, published by the Government of Eastern Bengal in 1907. By its aid he would have been able to explain the fact, to him mysterious, why a flat stone is placed before the trilithons which the Khasis erect in honour of deceased persons held in respect by the tribe.

IN the December (1909) issue of *Man* Major P. M. Sykes describes the system of tattooing in vogue in Persia. Until the last generation the practice was universal. Now it is rare among persons of rank, and is confined to the lower classes, especially in southern Persia. It seems to be partly ornamental, partly prophylactic. Women use it to avert the evil eye, to hide a scar or other blemish, or to cure disease. As usual, the trade is in the hands of Gypsy women; and though it prevails in Arabia, among the better-class Mussulmans in Persia it is now regarded as a relic of barbarism.

IN *Man* for December (1909) Mr. W. J. Lewis Abbott discusses the so-called "Pygmy" flint weapons. He gives a graphic sketch of the race which erected the Kitchen Middens at Hastings, and is disposed to associate the habit of making these implements with the Continental troglodytes who, he supposes, migrated north to Britain and southwards to the Mediterranean, Egypt, and India. This theory of primitive race migrations obviously involves many difficulties, and it is quite within the bounds of probability that this type of implement may have been independently evolved from more than one centre of origin. The geological evidence collected by Dr. Colley March in Lancashire is believed to show that they belong to an age far more remote than any deposit in which polished stone implements have been hitherto found.

IN the Journal of the Royal Society of Arts for December 17, 1909 (vol. lviii., pp. 101–29), Mr. Hugh Pearson gives a popular account of the diamond fields of Brazil, including the history of the industry since the first discovery of diamonds in 1729, brief descriptions of the geology of the different areas, and the methods of working the deposits. Details are furnished of the curious process of burning out the surface flaws by means of potassium nitrate. The loss in weight is about 8 per cent. There is an excellent general map showing the relative positions of the diamond fields, as well as local maps on a larger scale.

THE constant σ of Stefan's law—the energy radiated by a black body at temperature $T°$ absolute $= \sigma T^4$—has generally been assumed to have the value $5{\cdot}32 \times 10^{-12}$, as deduced by Dr. Kurlbaum from his observations. M. Féry's recent observations give, however, $6{\cdot}3 \times 10^{-12}$. Owing to this disagreement MM. Bauer and Moulin have made a re-determination of the constant by heating a platinum strip *in vacuo* until the radiation from it was equal in amount to that from a perfectly black body at the melting point of gold (1064°). The electrical energy given to the strip was then measured. They deduce as the value of σ to within 1 per cent. $6{\cdot}0 \times 10^{-12}$, and are disposed to question the accuracy of Prof. Planck's expression for the energy of each wave-length sent out by a black body at any temperature. An account of the work is contained in the *résumé* of communications made to the Société française de Physique at the meeting on December 3, 1909.

THE *Physical Review* for December (1909) contains an abstract of a paper on a new modification of the cloud method of measuring the elementary electrical charge, and the most probable value of that charge, read by Prof. R. A. Millikan to the American Physical Society at its Princeton meeting in October. He observes single isolated drops having multiple charges, first when gravity is balanced by a vertical electric field and the drops are stationary, then when the drops fall under gravity, the field having been withdrawn. The mean value deduced from observations of drops composed of water and of alcohol, and having from two to six elementary charges, is $4{\cdot}65 \times 10^{-10}$, with a possible error of 2 per cent. This number is in close agreement with the values obtained by Prof. Planck and by Prof. Rutherford and Dr. Geiger by other methods, but differs widely from those obtained previously by Sir J. J. Thomson, Prof. Townsend, and Prof. H. A. Wilson.

IN the U.S. Geological Survey's Bulletin No. 401, 1909, Mr. George F. Becker discusses the origin of petroleum and other natural hydrocarbons, with numerous references to authorities. He considers it proved that some oils are of organic, others of inorganic, origin. So far, however, as any direct evidence goes, "the great petroleum pools . . . may have been derived from carbonaceous matter of vegetable or animal origin . . . (or) from carbides of iron or other metals." The possibility of the latter origin led Mr. Becker to consult Dr. L. A. Bauer's map of magnetic declination in the United States. This he reproduces, marking on it where petroleum exists, and concludes:—"What the map does prove is that petroleum is intimately associated with magnetic disturbances similar to those arising from the neighbourhood of minerals possessing sensible magnetic attraction. . . . Henceforth no geological theory of petroleum will be acceptable which does not explain this association." Mr. Becker's conclusions, if confirmed, promise a new and important sphere of usefulness for magnetic surveys.

The Patents and Designs Act, 1907, forms the subject of an article, by Mr. George Schuster, in the December (1909) number of the *Economic Journal.* Mr. Schuster deals mainly with the effect which the Act has had upon the practice pursued by some foreigners of taking out British patents for the purpose, not of working them in the United Kingdom, but of preventing them being worked there. He states that there has not been any petition for revocation under Sec. 27 in which the revocation would have led to the establishment of an important industry in the United Kingdom, and points out that this fact, when considered in conjunction with the other evidence, affords conclusive proof that the original evil was greatly exaggerated, and accordingly that the hopes of benefits to be felt on its removal could not in any case have been realised. This conclusion justifies the note of warning given in Nature for July 23, 1908, immediately before Sec. 27 came into operation, in the following words:—"Much has been written lately as to the benefits to this country likely to be produced by this section, and in some cases there has been considerable exaggeration of the probable effects."

Prof. R. H. Smith contributes an article on a new formula for the total heat of steam in the *Engineer* for December 24, 1909. Prof. Smith has been led to analyse the law of total heat algebraically in consequence of the publication of a new set of tables compiled by Prof. L. S. Marks and Mr. H. N. Davis, of Harvard University. These tables are consistent between their different columns, and also seem to give data really trustworthy for comparatively strict accuracy. The formula, which represents with complete accuracy the figures of the new table throughout the whole range from 70° F. to 500° F., is as follows:—

Total heat from 32° F. of saturated steam:

$$H = 1826 + t - \frac{1{,}250{,}000}{1020 - t}.$$

The author gives an abbreviated table for comparison of the tabular numbers given by Marks with the results as calculated by the new formula; the comparison shows very close agreement, excepting for temperatures below 60° F. and above 500° F. It will, of course, be remembered that it is very difficult to make accurate heat experiments on very low-pressure steam, and also that no trustworthy experimental data as yet exists for temperatures above 400° F., the tabular numbers given by Marks having been extrapolated.

In the note on Mr. Knocker's address on the arrangement of ethnological collections in provincial museums in Nature of December 16, 1909 (p. 198), the word *geographical* should have been *non-geographical.*

Messrs. Williams and Norgate will publish almost immediately "Beet-sugar Making and its Chemical Control," by Mr. Y. Nikaido. The author has endeavoured to explain, not only the practical operations of sugar-house stations, but also the fundamental principles involved in the various processes of the sugar house and in the methods for analysis of various sugar-house products.

Messrs. W. and G. Foyle, 135 Charing Cross Road, London, W.C., have just issued a new edition of a classified catalogue of scientific and technical books. The catalogue contains a selection of books which can be supplied both new and second-hand, and, so far as it goes, it should prove of service to students seeking books on particular subjects.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in January:—

Jan. 7. 5h. Venus at greatest brilliancy.
,, 9h. Saturn at quadrature to the Sun.
8. 14h. Neptune at opposition to the Sun.
10. 1h. Mercury at greatest elongation, 19° 2′ E. of the Sun.
11. 0h. 14m. Uranus in conjunction with the Moon (Uranus 3° 9′ N.).
,, 18h. Uranus in conjunction with the Sun.
12. 9h. 12m. Mercury in conjunction with the Moon (Mercury 4° 33′ N.).
13. 15h. 22m. Venus in conjunction with the Moon (Venus 7° 43′ N.).
16. 12h. Mercury stationary.
17. 3h. 45m. Saturn in conjunction with the Moon (Saturn 1° 34′ N.).
,, 16h. Mars at quadrature to the Sun.
,, 19h. 19m. Mars in conjunction with the Moon (Mars 4° 25′ N.).
20. 2h. Venus stationary.
23. 16h. 5m. Neptune in conjunction with the Moon (Neptune 4° 5′ S.).
29. 21h. Jupiter stationary.
30. 12h. 5m. Jupiter in conjunction with the Moon (Jupiter 2° 45′ S.).

Halley's Comet.—The following is an extract from the corrected ephemeris for Halley's comet published by Mr. Crommelin in No. 4379 of the *Astronomische Nachrichten*:—

Ephemeris for Greenwich Noon.

1910	R.A. h. m.	Decl. ° ′	log r	log Δ
Jan. 5	2 4·6	+10 56	0·2984	0·1568
10	1 49·4	+10 15	—	0·1704
15	1 36·2	+ 9 39	0·2664	0·1851
20	1 24·7	+ 9 9	—	0·2001
25	1 14 9	+ 8 45	0·2310	0·2147
30	1 6·4	+ 8 27	—	0·2284

Thus we see the comet is about to pass from Aries into Pisces, and may be observed, with a sufficiently powerful instrument, at any time during the evening before midnight.

Observations made at Utrecht on November 8, 13, 17, 19, and 21, 1909, by Drs. Nijland and J. v. d. Bilt, indicated the increase of brightness shown by the following magnitudes:—13·5, 13·0, 12·8, 12·8, and 12·7.

Elements and Ephemeris for Daniel's Comet, 1909*e*.—In No. 4379 of the *Astronomische Nachrichten* Dr. Ebell gives a set of new elements and an ephemeris for Daniel's comet, 1909*e*. From these we learn that perihelion passage occurred on 1909 November 27·6694 (M.T. Berlin), and that the comet is now but little more than half as bright as it was at the time of discovery. Its position for

January 6 is $\alpha=6$h. 18·5m., $\delta=+53° 48{\cdot}1'$, and it is still moving northward slowly.

Solar Activity and Magnetic Storms.—No. 1, vol. lxx., of the Monthly Notices (November, 1909) contains three papers on the connection between solar activity and magnetic storms.

In the first, Dr. W. J. S. Lockyer discusses a series of spectroheliograms taken at the Solar Physics Observatory, South Kensington, and shows that the enormous magnetic disturbance of September 25, 1909, was preceded by an abnormal outburst in connection with a spot then on the sun. One of these photographs shows that at about 10 a.m., September 24, the calcium flocculus surrounding the spot was so disturbed as to obliterate the very fine nuclei seen on the preceding photographs; these nuclei reappeared on a negative taken at 11h. 11m. the same morning.

The time of the maximum magnetic disturbance appears to have been 4h. 30m. p.m. on September 25, showing a "lag," after the solar disturbance, of about 30·5 hours. In a similar case, in 1892, Prof. Hale found that the "lag" was about 25·3 hours.

In the second paper, Father Cortie deals generally with the recent solar and magnetic disturbances, and points out that this spot was not accompanied by any abnormal, visual, spectroscopic outburst commensurable in intensity with the magnetic disturbance.

In the last paper Mr. Michie Smith shows, from the evidence of the spectroheliograms and magnetograms secured at the Kodaikánal Observatory, that a great eruption about a spot photographed on September 28, 1909, was accompanied by a magnetic disturbance.

Star Swarms.—In an article which appears in the current *Fortnightly Review* (p. 140), Prof. Turner gives a very interesting and lucid popular account of "Migrating Stars."

The difficulties and results of Prof. Boss's work in showing that a number of stars in Taurus are moving together, apparently to a convergent but really along parallel paths, are clearly explained and illustrated by some attractive analogies. This cluster is now some 120 light-years from us, and occupies a space on the celestial globe comparable with that occupied by India on the terrestrial; but in about 6[illegible] million years it will have receded so far as to appear merely as a star cluster, occupying an area, using the same analogy, about equal to Anglesea.

The researches of Dr. Ludendorff on the related stars of Ursa Major, and of Dr. Hertzsprung, who has added Sirius, α Coronæ, and other stars to it, are also described.

In No. 4366 of the *Astronomische Nachrichten*, Herr Kostinsky directs attention to two swarms of stars in the neighbourhood of the star clusters χ and h Persei, the individual members of which appear to partake of motions in a common direction.

A Large Nebula in Cetus.—On a plate taken in the autumn by Herr Lorenz, Prof. Wolf found traces of a large patch of nebulous matter in the constellation Cetus, and has recently succeeded in photographing it with the Waltz reflector. The negative obtained, with two hours' exposure, shows that the object is a long streak running in the N. and S. direction, its length being 15′; at the broadest part, E. and W., its breadth is 3′. The position of the central part of the nebula is $\alpha=23$h. 54·6m., $\delta=-16° 15'$ (1855·0), and the whole is seen to be a conglomeration of smaller nebulæ (*Astronomische Nachrichten*, No. 4380, December 28, 1909, p. 187).

Annuaire astronomique et météorologique, 1910.—For the amateur observer conversant with French, there are few more useful volumes than M. Flammarion's "Annuaire." This year's issue is very similar to its predecessors, but contains a useful *résumé*, with many drawings, of the observations of Mars during the recent opposition. Solar observers, wishing to chart sun-spots, will find the "Disques Moreux," figured on p. 67, a useful adjunct to their outfit. The climatology of 1908 is reviewed, and at the end of the volume there are some useful instructions on the use of instruments for people commencing astronomical observation.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES.

At the annual public meeting of the Academy of Sciences, the president, M. Ch. Bouchard, delivered the annual address, dealing with the population question in France, and announced that the prizes for the year 1909 had been awarded as follows:—

Geometry.—The Francœur prize to Émile Lemoine, for the whole of his works; the Bordin prize to G. Bagnera and Michele de Franchis, for their memoir on the number ρ of M. Picard for hyperelliptic surfaces.

Mechanics.—A Montyon prize to M. Lecornu, for his book on applied dynamics; the Poncelet prize to M. de Sparre, for the whole of his works; the Boileau prize to M. Boulanger, for his treatise on hydraulics. No satisfactory memoirs having been received on the subject proposed for the Vaillant prize, this has been postponed until 1911.

Navigation.—The Prix Extraordinaire de la Marine divided between M. Marbec, for his memoir on the theory of the equilibrium of an elastic plate submitted to a uniform pressure; M. Doyère, for his work on submarines; M. L. J. H. Lecoq, for work on the stability of submarines; MM. Victor Colin and Jeance, for their work on wireless telephony; M. Tissot, for work on wireless telegraphy; and M. E. Fromaget, for his river survey work in eastern French Africa. The Plumey prize between M. Routin, for his work on the regulation of electrogenic groups, and M. Henry Caralp, for his book on boilers and engines in warships.

Astronomy.—The Lalande prize to M. Borrelly, for his work as a whole; the Valz prize to M. de la Baume-Pluvinel, for his work on solar eclipses and the constitution of comets; the G. de Pontécoulant prize to Prof. E. W. Brown, of Yale, for his work on the theory of the moon. The Pierre Guzman prize was not awarded, and the Damoiseau prize postponed until 1911, no memoirs having been received on the subject proposed.

Geography.—The Tchihatchef prize was not awarded, but M. Henry de Bouillane de Lacoste receives a very honourable mention (2000 francs); the Gay prize to M. L. Joubin, for his researches on the distribution of marine plants in the Roscoff region.

Physics.—The Hébert prize to M. Paul Janet, for his book on general electrotechnics; the Hughes prize to M. Meslin, for his researches in physical optics, magneto-optics, and physical astronomy; the Gaston Planté prize to M. Jean Perrin, for his researches on the kathode rays and on the Brownian movement; the La Caze prize to M. Léon Teisserenc de Bort, for his contributions to meteorology and physics of the globe.

Chemistry.—The La Caze prize between M. G. Blanc, for his researches on the derivatives of camphor, and M. Marcel Guerbet, for his contributions to organic chemistry; the Cahours prize between MM. Carré, Jolibois, and Brunel; Montyon prize (unhealthy trades) to MM. Émile Lefranc, Paul Letellier, and Maurice Perrot; the La Caze prize to M. Recoura, for his work on chromium compounds.

Mineralogy and Geology.—The Grand prize of the physical sciences to M. A. Thévenin, for his memoir on the stages of evolution of the most ancient quadrupeds found in France; the Delesse prize to M. Ph. Glangeaud, for his contributions to the geology of the Auvergne; the Victor Raulin prize (1908) to M. Léon Bertrand, for his contribution to the stratigraphical and tectonic history of the eastern and central Pyrenees, and (1909) to M. Ferdinand Gonnard, for his mineralogical researches; the Joseph Labbé prize to M. Georges Rolland, for his geological studies relating to the mine basin of Meurthe-et-Moselle.

Botany.—The Desmazières prize to M. l'Abbé Hue, for his researches on lichens; Montagne prizes to MM. H. and M. Peragallo, for their work on French marine diatoms, and M. Guilliermond, for his researches on the structure of the Cyanophyceæ and bacteria; the de Coincy prize to M. René Viguier, for his work on the Araliaceæ; the Thore prize to M. Paul Bergon, for his researches on the structure and development of diatoms.

Anatomy and Zoology.—The Savigny prize to M. Robert du Buysson, for his entomological studies in Egypt; the da Gama Machado prize to MM. J. Pantel and R. de Sinéty, for their studies in spermatogenesis; the Cuvier prize to M. Charles Janet, for his anatomical and embryological researches on ants.

Medicine and Surgery.—Montyon prizes to MM. Neumann, Ch. Nicolle, Bergonié, and Tribondeau, mentions being accorded to MM. Moussu, H. Truc and P. Chavernac, Ch. Porcher and Ch. Hervieux, and a citation to MM. Henri Claude and Jean Camus. The Barbier prize between M. L. Launoy, for his researches on the conditions of activity of glandular cells, and M. J. Lesage, for his experimental studies on maté (*Yerba maté*). The Breant prize was not claimed, but from the interest of the fund a prize of 4000 francs was awarded to W. M. Haffkine, for his work on vaccination against cholera and plague, and a mention of 1000 francs to M. Louis Rénon, for his memoir on the practical treatment of pulmonary tuberculosis; the Godard prize to M. A. Pousson, for his work on the surgery of nephritis, and a very honourable mention to M. J. L. Chirié, for his studies on arterial hypertension; the Baron-Larrey prize to M. Niclot, for his researches on the relations between the numbers of Anopheles and cases of malaria in the Oran district, and a very honourable mention to MM. Dupard and Lepourcelet, for their contribution to the study of meat in the army; the Bellion prize to M. Ch. Nicolas, for his work on public and private hygiene in the Loyalty Islands; the Mège prize (interest) to M. S. J. Metalnikoff, for his researches on *Galleria mellonella*; the Parkin prize to M. Ad. Cartaz, for his therapeutical studies on carbon dioxide as applied to diseases of the nose and throat.

Physiology.—Montyon prizes to M. Charles Dhéré, for his spectrographic researches on the absorption of the ultra-violet rays by albumenoids, proteids, and their derivatives, and to M. E. Pozerski, for his contribution to the physiological study of papaine; the Philipeaux prize to MM. J. E. Abelous and E. Bardier, for their discovery of urohypertensine; the Lallemand prize between M. August Pettit and Gustave Roussy; the La Caze prize to M. C. Delezenne, for the whole of his researches in physiology. The Pourat prize was not awarded, and is postponed to 1911.

Statistics.—A Montyon prize to M. Louis de Goy, for his financial studies, M. Ausset receiving an honourable mention.

History of Science.—Binoux prizes to M. P. Duhem, for the whole of his works relating to the history of science, and M. J. B. de Toni, for his historical studies on the life and work of Italian philosophers of the fifteenth and sixteenth centuries.

General Prizes.—Berthelot medals to MM. G. Blanc, Marcel Guerbet, Jolibois, Brunel, Émile Lefranc, Paul Letellier, Maurice Perrot; the Gegner prize to M. J. H. Fabre; the Lannelongue prize to Mme. Cusco and Mme. de Nabias; the Trémont prize to M. Charles Frémont; the Wilde prize to M. Joseph Vallot, for his work on Mt. Blanc; the Longchampt prize to M. Claudius Roux, for his work on the chlorosis of plants; the Saintour prize to MM. E. F. Gautier and R. Chudeau, for their scientific studies in the Sahara; the Jean Jacques Berger prize between MM. Bienvenue (3000 francs), Biette (1000 francs), Locherer (1000 francs), Thomas (1000 francs), Faillié (750 francs), Hervieu (750 francs), Chagnaud (750 francs), Daydé and Pillé (750 francs), and Calmette (6000 francs). The Petit d'Ormoy prizes were not awarded. M. E. Mercadier receives the Pierson-Périn prize for his physical researches; M. Ritz and M. Lebeuf, 2000 francs each from the Leconte fund; M. Vaucheret, the prize founded by the Marquise de Laplace; and MM. Vaucheret, Hentschel, Messiah, and Courtaigne the prize founded by M. Felix Rivot.

The Bonaparte Fund.—The committee proposes the following grants from this fund for the year 1909:—M. Cayeux, 4000 francs, to enable him to follow up in the United States his researches on oolitic iron-ore deposits, already commenced in France; M. Chevalier, 4000 francs, to assist his explorations in tropical Africa; M. Pérez, 4000 francs, to assist in the publication of a memoir entitled "Recherches histologiques sur les Métamorphoses des Muscides"; M. Houard, 3000 francs, to enable him to travel in Corsica, Algeria, and Tunis for the purpose of collecting material; M. Berget, 2000 francs, for the construction of a special form of pendulum for studying the variations of gravity; M. Bernard, 2000 francs, to assist him in his photometric studies of the variations of solar radiation; M. Blaringhem, 2000 francs, to enable him to continue his experimental researches on the variation of species; M. Estanave, 2000 francs, to permit him to continue his researches on stereoscopic vision, stereoradiography, and autostereoscopy; M. Mathias, 2000 francs, to enable him to continue his researches at the Leyden cryogenic laboratory on the rectilinear diameter of liquids and on the law of corresponding states at very low temperatures.

The academy, taking advantage of the freedom accorded it under the terms of the Petit d'Ormoy foundation, has decided this year not to give this prize in the usual form, but to strike medals commemorative of the progress made in flying. Gold medals have accordingly been awarded to Louis Blériot, Commandant Bouttieaux, Captain Crocco, Henri Farman, Captain Ferber, Henri Juilliot, Charles de Lambert, Hubert Latham, Léon Levavasseur, Col. Charles Renard and Commandant Paul Renard (one medal), Alberto Santos-Dumont, Rodolphe Soreau, Édouard Turcouf and Henri Kapferer (one medal), Léon Teisserenc de Bort, Henry de La Vaulx, Gabriel Voisin, Commandant Jules Voyer, Orville Wright, Wilbur Wright and Count de Zeppelin. Also silver-gilt medals to Gustave Hermite and Georges Besançon, Louis Breguet, Léon Delagrange, Robert Esnault-Pelterie, L. Marchis, Louis Paulhan, Henri Rougier, and Victor Tatin.

CLIMATOLOGICAL REPORTS.

THE director of the meteorological observatory at Chemulpo has issued the results of the observations made at the Japanese meteorological stations in Korea for each of the months January–December, 1908. The instruments and the method of observation are the same as those at the meteorological stations in Japan, and the readings, taken six times a day, are expressed in metric and centigrade measures, with monthly means and extremes. These form an important contribution to the meteorology of the Far East; their value would be much enhanced by the addition of annual summaries.

The report on rainfall registration in Mysore for 1908 shows that, except in the Shimoga (north-west) district, the amount was deficient in all parts of that important province, reaching 43 per cent. in Kolar (east). The deficiency of the fall during both monsoons was detrimental to the cultivation of ragi, which is the staple dry crop of the province. The tables for monthly, seasonal, and yearly periods have been carefully prepared by Mr. Iyengar, as before, with diagrams and maps showing (1) the annual rainfall for 1908, and (2) the average for 1870–1908. The mean amount for the whole province in 1908 was 29·94 inches, the average for the thirty-nine years' period being 36·79 inches. Among the heavy daily falls we note 11·22 inches in Shimoga district, and 10·90 inches in Kadur district, both in the month of July.

An important memoir on the climate of Tripoli is published in the Annals of the Italian Central Meteorological Office (vol. xxx., part i.), containing the results of observations made during the years 1893–1907, at an observatory established by the Italian Foreign Office and the Meteorological Service, and situated in lat. 32° 54′ N., long. 13° 11′ E. The mean monthly values of atmospheric pressure exhibit the greatest variability during the winter season, when the barometer is highest; the lowest readings occur during spring. The mean monthly temperatures do not show much variation from one year to another. The means of the daily maxima are 60·0° in January and 86·2° in August, and of the minima 46·1° in January and 72·9° in August. The absolute maxima and minima were 109·0° in July and 34·5° in January. The mean annual rainfall is 17·29 inches, most of which falls between October and February (14·85 inches); from June to August inclusive little or no rain falls. The memoir has been carefully prepared in considerable detail by Profs. Martinuzzi and Eredia, and is especially valuable, as comparatively little has hitherto been published on the climatology of that country.

In the annual summary of the *India Weather Review* for 1908 the observations included in monthly issues are discussed in detail, and the departures of the monthly and annual means from the normal values are calculated for each element. Dr. Walker states that, on the whole, 1908 was cooler than usual, although in April and June, both of which were dry months, the temperature was in decided excess of the normal. Excluding the hill stations, 1908 was a year of average rainfall; of the four seasons, the cold weather and south-west monsoon were more rainy than usual, while the other two periods were markedly dry. With respect to the monsoon rainfall, the character was opposite to that prevailing in the previous seven years, all of which were in defect. The most striking feature of the year was the heavy rainfall in the dry zone of north-west India, due to the strong monsoon currents in July and August.

The report of the Transvaal Meteorological Department, containing observations and results in the usual form for the year ended June 30, 1908, has been received. The number of rainfall stations has greatly increased, and includes those which formerly reported to the Irrigation Department. The rainfall was below the average generally; at Pretoria the deficiency amounted to 31 per cent., and at Johannesburg to 10 per cent. Farmers suffered from want of water, but, among the compensating factors, remarkable freedom from locusts and little damage from hailstorms are mentioned. In connection with this report we may refer to interesting contributions by Mr. Innes (director) and Mr. Wood (chief assistant) to the climatology of the Transvaal in the current number of the Journal of the Scottish Meteorological Society. Mr. Innes remarks that it is one of the sunniest climates inhabited by civilised races, the average cloudiness being about 30 per cent., and the relative humidity low. Speaking of the High Veld generally, which is at an elevation of about 4000 feet, it is warm by day and cool at night. The rainfall averages 25 to 30 inches, the number of days with rain being only about eighty-five. At places like Johannesburg (5750 feet) the cold during winter is considerable, owing more to the cold wind than to actual temperature. Over the latter (Witwatersrand) district Mr. Wood shows that the mean monthly rainfall increases with great regularity from July (0·11 inch) to January (5·80 inches), and then diminishes to June (0·09 inch). The probability of heavy rainfalls (1 inch and above) is entirely confined to the months October–March inclusive.

The Department of Agriculture, Nairobi, has issued its fifth annual report of meteorological records in British East Africa, containing monthly rainfall values for fifty-six stations during 1908, and averages for ten years (1899–1908) and under at twenty-five stations. The latter show that the mean annual rainfall varied from about 16 inches at Kismayu to 72 inches at Mumias. Meteorological summaries for 1908 are given for ten stations; so far as these show, the absolute extremes of temperature were 99° at Nandi (6000 feet above sea) in February, and 35° at Elmenteita (height not stated) in January.

The Weekly Weather Report issued by the Meteorological Office, London, for the period ending January 1 contains a summary of temperature, rainfall, and bright sunshine for the year 1909. From this it is seen that for the fifty-two weeks ending January 1 the temperature was below the average over the entire kingdom. The rainfall was in excess of the average in all the English districts except in the south-west, but it was generally deficient in Scotland and Ireland. The largest aggregate measurement of rain is 47·12 inches, in the west of Scotland; the least amount for the year is 26·04 inches, in the east of England. The greatest excess of rain is 5·21 inches, in the south-east of England, and the greatest deficiency 6·91 inches, in the north of Scotland, whilst in the north of Ireland the aggregate measurement was 5·53 inches deficient. The rainy days were in excess of the average over the entire country, except in the west of Scotland and in the English Channel. The greatest excess was twenty-two days, in the east of England. The greatest number of rainy days was 250, in the north of Scotland, and the least 186, in the south-east of England. The duration of bright sunshine for the year was in excess of the average over the whole of the British Isles, except in the north-east of England, where there was a deficiency of forty-three hours. The greatest excess was 146 hours, in the south-east of England. The longest duration of bright sunshine was 1975 hours, in the Channel Islands, and this was followed by 1743 hours in the south-east of England. The least duration was 1157 hours, in the north of Scotland, which, however, is forty-eight hours more than the average. The mean temperature at Greenwich for 1909 is 48·9°, which is 1·2° below the average of the past sixty years. The highest monthly mean is 62·7°, in August, the lowest 37·2°, in February. The temperature was below the mean in every month except in January, April, October, and December. The absolutely highest temperature was 86°, in August, the lowest 14°, in March, which gives a range of 72° in the year. The temperature was above the average on 144 days, and frost occurred on sixty-five nights, fifty-two of which occurred in January, February, March, and December. The total rainfall for the year was 25·71 inches, which is 1·58 inches more than the average of the last sixty years. The wettest months were June, July, and March, in each of which the total fall exceeded 3 inches. In all, rain fell on 186 days, December having as many as twenty-three wet days and March twenty-two. There were during the year 1637 hours of bright sunshine at Greenwich, which is 138 hours more than the average. The sunniest month was May, with a record excess of 140 hours. Snow fell on twenty-four days and fog occurred on forty-three days during the year.

EDUCATIONAL TENDENCIES IN THE UNITED STATES.

THE first volume of the report of the U.S. Commissioner of Education for the year ended June 30, 1909, has now been published, and is consequently available at an earlier date after the conclusion of the year with which it deals than any previous report. The second and concluding volume of the report is to be issued early in March next.

The present instalment, which runs to 598 pages, is prefaced by an introduction by the Commissioner, Dr. E. E. Brown, which gives a brief *résumé* of the more important subjects dealt with at length in the succeeding chapters. It is possible here to refer to a few only of the numerous subjects of interest discussed in the volume.

Industrial education has commanded attention in all parts of the States during the past year. The report points out that it has become increasingly evident that one of the vital elements of the problem, so far as the United States are concerned, is the question of the relation of school training to shop practice or apprenticeship. Accounts are given of several experiments which are being tried in various States. The special combination of shop practice with regular scholastic training, which was introduced two or three years ago by the University of Cincinnati, is receiving much attention, and a modification of this plan has been carried into effect in the public schools of Fitchburg, Mass. Model and practice schools have been provided for the teaching of manual arts in connection with the State normal school in Fitchburg. A cooperative course in preparation for the metal trades has been introduced into the Lewis Institute, in Chicago, for boys from sixteen to twenty years of age. Each boy in each of the two years of this course spends twenty-six weeks in the shop and twenty-four weeks in school, receiving from his employer the school tuition fee of 10*l.* a year and 1*l.* a week for the time he works in the shop. The report emphasises the fact that many diverse and often opposing interests are concerned in the effort to work out an American system of industrial education. All these interests are to be given full and fair consideration, and it is being borne in mind that, to render such a system stable and altogether American, it must be made genuinely educational.

Agricultural education has been stimulated during the year by the inquiries and the report of the Commission on Country Life, appointed by President Roosevelt. The establishment of agricultural high schools in different parts of the country goes forward steadily. Mississippi and Arkansas have made important beginnings in the establishment of such schools during the year, and Minnesota has provided for agricultural departments in the graded schools of the State.

Referring to American colleges and universities, Dr. Brown gives it as his opinion that among the leaders of American university education there is a growing and surprisingly unanimous conviction regarding the directions in which improvement should be made in higher education in the States. It is to be rendered more coherent, vital, and democratic. As President Butler has remarked:—"The American college is under fire, no doubt. Well-directed intelligent firing will do it good. It is far from perfect, but it knows its job, and is working at it with the skill born of long and successful experience." The democratic movement in higher education has been emphasised during the year by the effort to organise in Massachusetts an institution which shall bring courses of college instruction home to all communities in the State in which it may be desired—a project which has been referred by the Legislature to the new State Board of Education for an opinion as to its advisability; by the step taken by Cornell University in the direction of the State university form of organisation, and by the beginnings at the University of Wisconsin of a more comprehensive and widely diffused system of university extension.

Within the year the University of Wisconsin has been a centre of public interest in a variety of ways, not the least important of which is the Vilas bequest, which is expected to amount to 400,000*l*., and to be administered so that it shall eventually reach a total of 4,000,000*l*. The fact that the available income of this fund is to be devoted largely to research renders it an epoch-making endowment.

In addition to its treatment of the problems of American education, the volume provides an admirable series of summaries of educational progress in European and other countries. Separate chapters are devoted to educational problems in Hawaii, the Philippines, Porto Rico, the Argentine Republic and Chile, Great Britain and Ireland, France and Central Europe. Educational reform in China and current educational topics in foreign countries each receive special treatment.

These educational reports from Washington have often been praised in these columns, and it will suffice to say that the latest report fully maintains the excellence of its predecessors.

OLE RÖMER AND THE THERMOMETER.[1]

THE first thermometers of which the indications were independent of atmospheric pressure appeared in the latter half of the seventeenth century, but Fahrenheit was the first one to succeed, in 1710, in solving the problem of furnishing these thermometers with such scales that their indications agreed; these thermometers were much admired, and represented great progress. It may therefore be of interest to show that Ole Römer solved this problem before Fahrenheit, and that it was from him that Fahrenheit obtained his method.

From some stray remarks which I happened to come across in scientific literature of the eighteenth century, I saw that Ole Römer probably occupied himself with the construction of thermometers, and that some connection existed between him and Fahrenheit. These statements had the effect of inducing me to look for traces of Römer's work in the libraries and archives here in Copenhagen. In the university library I found what I was looking for—a work by Römer called "Adversaria," a volume of written papers in folio bound in a brown cover.[2]

The book contains a whole section about the thermometer, besides some scattered statements about temperature measurements, which I shall return to later. The arrangement of Römer's thermometer seems to me to be of considerable interest. Römer appears to have been the first to construct thermometers with the two fixed points, the temperature of melting snow—"Nix sine gelu et calore"—and the boiling point of water, and with the cubic contents of the tube divided into equal parts. Both Römer and Horrebow's remarks seem to indicate that this took place about the year 1702. The first part of this section is mathematical, and deals chiefly with the problem of dividing the cubic contents of a conical glass tube into equal parts. Römer finds a general method of making such a division, and calculates approximate formulas by the aid of which he may carry out more easily his calculations; he employs these formulas in dividing the cubic contents of a conical tube 8 inches long, intended for his "original thermometer," into four equal parts, and he gives the length of these parts when he determines that the scale of the thermometer is to have sixty divisions, and these are to be arranged in such a way as to read "boiling 60, snow without cold or warmth $7\frac{1}{2}$." After these preliminary investigations Römer gives complete instructions in four paragraphs for "the construction of an original[1] thermometer."

"(1) By means of a drop of mercury investigate whether the cavity of the tube, be it cylindrical or conical, is regular before the ball is blown out. Irregular forms are to be rejected; the cylindrical form may be employed without further investigation. With regard to the conical forms, proceed as follows:—

"(2) From the middle of the tube towards the outer points take the lengths of the drop of mercury.

"(3) When by means of this experiment the divisions have been divided into two equal parts, each of these parts is in turn divided into two equal parts proportionally by increase or diminution, and the whole tube will thus be divided into four equal parts.

"(4) When the thermometer is completed, filled and closed, fix by means of snow or crushed ice the point of division $7\frac{1}{2}$, by means of boiling the point 60."

After these instructions there are remarks written in Horrebow's hand and with his signature which are supplementary, and show also that Römer's thermometer existed after his death (1710):—"... In 1739, Römer's widow sent me five glasses for thermometers which Römer himself had filled and divided with two points in accordance with his own rules given above. The alcohol in them is rather pale, although Römer coloured it with saffron in the usual manner. ... After this was written, I asked Römer's widow if she knew whether Römer, after I had left his observatories, had made any change in his thermometer. She said that she did not know, but she gave me Römer's *vade mecum*, in which I found a loose sheet, which is pasted in here after the next sheet. On that I read that Römer fixed upon 8 as the dividing-point for snow, and thus, so far as we know, the alcohol never sinks below 0 in Copenhagen, and it is to be remarked that January 7, 1709, the alcohol only sank to $7\frac{6}{10}$."

The loose sheet which Horrebow mentions contains a table of temperatures which gives the temperature for every day from December 26, 1708, to April 1, 1709.

The two following pages contain a sort of table of corrections for the four divisions.

After this short account of the contents of the eleven folio pages which Römer devoted to the construction of his "new" thermometer, it will be appropriate here to give a short explanation of his method and to point out what is new in it.

The chief feature of the method is this: to base the division of the thermometer on two fixed points, the melting point of thawing snow and the temperature of boiling water, and to find the length of the degree by dividing the cubic contents of the thermometer tube between these two points into equal parts, taking into consideration whether the tube is cylindrical or not. The size of the degree is obtained on the basis of the fact that there must be between the freezing point and the boiling point 52·5 degrees of equal cubic content. If the tube is cylindrical the whole length between the two fixed points is divided into $52\frac{1}{2}$ equal parts, and 7·5 similar parts are added below the freezing point, zero being thus determined. If the tube is not cylindrical, but conical, an investigation of the dimensions of the tube is made according to the method described in the introduction, the result obtained being the relation between the length of that part of the tube enclosing the seven-eighths of the cubic contents nearest the boiling point and the whole length which is to be employed for the 60°; in the example which Römer takes the conditions are such that the length of the tube between the boiling point and the freezing point must be divided into 52·2 equal parts, 7·8 parts to be added below the freezing point, zero thus being obtained. In using such a thermometer with a conical tube, it is necessary to have a table giving the readings in terms of degrees; thus the reading 7·8 on the length of the tube meant, in terms of Römer's thermometer, 7·5°, 15·563 meant 15°, &c.

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[1] v. Kirstine Meyer: Temperaturbegrebets Udvikling gennem Tiderne og dets Forhold til vekslende Anskuelser om Varmens Natur. Gjellerups Boghandel. Inaugural Dissertation. (Copenhagen, 1909.)

[2] The language in "Adversaria" is chiefly Latin; the book will be published in 1910 under the auspices of the Kgl. danske Videnskabernes Selskab.

[1] Some weights which are still in existence from Römer's time, and probably are those that he constructed as standards for the new system of weights and measures introduced by the Act of May 1, 1683, bear the inscription "original weight." From this it may be inferred that "original thermometer" means "standard thermometer," and that it was Römer's purpose to introduce a standard for thermometers as for other units of measure.

Three questions naturally arise when we see that Römer used so much of his limited time in constructing on "original" thermometer:—(1) Is this interest in any way connected with the rest of his scientific or practical work? (2) Did he use the thermometers thus constructed for systematic measurements? (3) Have his new ideas in this line contributed anything to the improved construction of thermometers on the whole? In "Adversaria" there are indubitable indications that the first two questions are to be answered in the affirmative; he gives very excellent results of experiments on "the change of length in metals caused by cold and heat," and, furthermore, there is a sketch of an apparatus for comparative measurements of the expansion of gases and liquids when exposed to heat, and some good results of these measurements. There is also, as already mentioned, a series of measurements made with the new thermometer of the temperature of the air in Copenhagen during the winter of 1709. These measurements are of special interest, and are mentioned several times in the literature of foreign countries. The winter of 1709 was very severe. In an article in Phil. Trans., No. 324, 1709, W. Derham writes, in "The History of the Great Frost in the last Winter," about the conditions in Denmark:—"Dr. Woodward tells me, that in a lettre, he received from the learned Mr. Otto Sperling from Copenhagen, dated April 6, 1709, he calleth it Hyems Atrocissima. And I find it noted in the Minutes of the Royal Society of May 4, 1709. That Dr. Judichar said the ice was frozen in the harbour of Copenhagen 27 inches, and that April 9 N.S. people had gone over between Schone and Denmark on the ice. Which accounts give me a better opinion of some papers I have by me which were shew'd to the Society, concerning the frost at Copenhagen pretended to be taken from the observations of Mr. Römer. I should not entertain any the least distrust of the accuracy either of the instruments or observations of that eminent person were I sure they were his. But there are some passages and hints in those papers that lessened others as well as my opinion about them. 'Tis said there 'That such a frost hath not been known in the memory of man of these countries and *that*[1] *the frost on January 7 and February 23, 170$\frac{8}{9}$, did very nearly approach the Point of Artificial Freezing.*'" If we now look at the table of Römer's temperature observations from 1708–9 which is found in "Adversaria," it will be seen that it begins December 26, 1708, and continues until April 9, 1709, only that after April 1 there are not observations for every day, and this is no doubt due to the fact that the table is only calculated to show temperatures under 8°. The remarks along the margin are written in Horrebow's hand. The first remark is:—"So Römer had changed his first plan." The meaning of this is, as may be seen from Horrebow's other remarks in "Adversaria," that he thinks that Römer had placed 8 at the melting point instead of 7½ as earlier.

Now the table shows that on February 23, exactly the date which Derham especially mentions, the thermometer went down to about Römer's zero. It is important to note the exact wording of Derham's remark, "that the frost, February 23, 170$\frac{8}{9}$, came near the temperature for artificial freezing." So it is evidently taken for granted here that *Römer's zero was the temperature of a freezing mixture*, a fact which Derham must have obtained from the report sent from Denmark, since he was not acquainted with Römer's scale. This remark is of special importance for the question as to whether, and if so through what channels, Römer's thermometer has had any widespread influence. The answer is in the affirmative, and the way in which Römer exercised a wide influence was through his influence on Fahrenheit. I shall now proceed to prove that such an influence was exercised by Römer.

In the first place, there are some direct statements about this matter. The most important is by Boerhaave, who, in writing about Fahrenheit's thermometer, says:—"Now it is said that the eminent mathematician Römer in the year 9 of this century observed in Danzig a winter-cold down to the first degree of *this same* thermoscope, of which he himself was the first inventor. Then he increased it with 32° below the freezing-point."

So here it is stated quite distinctly that Römer was the first inventor of Fahrenheit's thermometer; and importance is to be attached to Boerhaave's words about this matter, because he was closely connected with Fahrenheit, who had constructed his thermometers, and whose skill as an instrument-maker and experimenter he often speaks of in terms of praise. That Römer should have made measurements in Danzig in 1709 must be a mistake, which can easily be accounted for by the fact that there are accounts of measurements made in Danzig the same winter with a similar thermometer. At least, I have not been able to find any indications that Römer was in a foreign country at the time mentioned, and his many official duties, his delicate health, and that very list of temperatures for Copenhagen which was sent to the Royal Society make it improbable that he was away from home.

On the other hand, it is related in a biography[1] of Fahrenheit, written four years after his death, that after 1706 he made many difficult journeys by sea and by land, and conferred with the most famous mathematicians in Denmark and Sweden; it is probable that Ole Römer was one of the famous men whom he visited, and then Fahrenheit must have visited him just at the time when the "original thermometer" was used; if Boerhaave's statement is correct, it must be possible to trace Römer's influence on Fahrenheit's thermometers. What Fahrenheit could learn from Römer was chiefly the principle of the two fixed points as a basis for the thermometer scale. According to Fahrenheit's own brief account[2] of his method in the construction of his thermometers, he does, in fact, use fixed points as a basis for his scale, but he mentions three: the temperature of the freezing point, the temperature of a cold mixture, and the temperature of the healthy human body; the last, however, is apparently only used as a sort of check, because Fahrenheit does not wholly rely on the constancy of the temperature of the cold mixture. Now Fahrenheit probably took the two fixed points from Römer, since the zero of Römer's scale, as was evident from Derham's account, was identified with the temperature of a cold mixture, and it appears that the scales of several of the oldest of Fahrenheit's thermometers have the same numeration as Römer's. These thermometers are mentioned in various places; Grischow[3] especially has a full comparison of the somewhat varying scales which Fahrenheit used at different times.

According to Grischow[4] and others,[5] Fahrenheit is said to have confided to his tutor in mathematics, Barnsdorf (from Rostock), the secret of the method of division used on his thermometer, which he maintained was such that anyone who knew it could construct thermometers which agreed. Grischow writes that this happened "circiter 1712 and 1713 nise jam ante." Shortly after that Fahrenheit travelled to Halle and Leipzig, and then Barnsdorf, in conjunction with a colleague named Lange, tried to construct thermometers after the instructions. The scale on these was somewhat different from that on the thermometers which were generally known later as Fahrenheit's, and we read about Barnsdorf that he probably retained "the older or oldest Fahrenheit division." Now from the table it appears that Barnsdorf's thermometers have 7½ at

[1] Emphasised by K. M.

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[1] Altpreuss. Monatsschrift, ii., 1874, contains a fragment edited by E. Strehlek.

[2] Phil. Trans. London, vol. xxxiii., 1724, pp. 78–84.

[3] Miscell. Berolienses, t. vi. (printed 1737).

[4] *Loc. cit.*, p. 271.

[5] Cotte, "Traité de Météorologie," 1774, p. 129.

the freezing point and 22½ at the temperature of the human body, and these larger degrees are again divided into smaller ones, namely, each degree into eight. At all events, this idea of placing 7½ at the freezing point, together with all the other facts that have been mentioned, seems pretty certainly to prove Römer's influence, since it is highly improbable that two persons independently would both think of placing 7½ at the freezing point. Barnsdorf's zero is somewhat higher than that of the later Fahrenheit thermometers.

There is other evidence that Fahrenheit used 7½ at the freezing point and had his original zero a little higher than the later one. In 1737 Prof. Dn. Kirch described[1] a thermometer which he had received from Fahrenheit more than twenty years before. He states there that his thermometer has 7½ at the freezing point, and that his zero lies somewhat higher than that on the later Fahrenheit thermometers.

One more thermometer—perhaps the very oldest—seems based upon a division with fixed points and a scale like Barnsdorf's, although the division, apparently, is quite different. Grischow writes in 1740 that a large thermometer which Fahrenheit had constructed thirty years before for the Royal Society in Berlin, and consequently constructed with the greatest care, still agrees completely with the little thermometers which Fahrenheit had sent a short time before from Amsterdam to Berlin. These small thermometers were graded with the help of two or three fixed points, and are throughout like those we use now. So the first thermometer was also constructed according to fixed principles, for such agreement cannot be due to mere chance; a similar thermometer, which had been used for observations in 1709, and which certainly is one of the first Fahrenheit thermometers constructed, was found in Danzig in 1740.

This thermometer was apparently divided after the manner of the Florentine thermometer: 90 at the temperature of the body, 0 at about summer heat, 90 at the lowest degree of heat (which accordingly corresponded to zero on a Fahrenheit thermometer), and 30 at the freezing point. From the lowest to the highest degree of heat, then, there are $180^\circ = 8 \cdot 22\frac{1}{2}$, from the lowest degree of heat to the freezing point $60^\circ = 8 \cdot 7\frac{1}{2}$, accordingly like Barnsdorf's.

In 1714 Fahrenheit constructed two thermometers for Chr. von Wolf, Chancellor of the University of Halle, who was very enthusiastic about them, and has given a description of them.[2] The scale had 26 degrees; the second degree on the scale was marked "greatest cold," so that from this point to the top of the scale there were 24 degrees; the eighth degree was marked "cold." It reminds us perfectly of a scale which Grischow gives for the older Fahrenheit thermometers with the fixed points 0, 8, 24, which later were changed to 0, 32, 96. So here Fahrenheit hesitated—just as, perhaps, Römer did, according to Horrebow's opinion—and he took 8 instead of 7½. However, taken all in all, there are strong indications that it is Ole Römer's strange number for the freezing point which is the origin of the 32° Fahrenheit now used for this point.

Now, perhaps the objection may be made that if Römer's scale were to be traced in Fahrenheit's, we should find $4 \cdot 60 = 240$ at the boiling point, and not 212; but there is an explanation for this. According to those descriptions of the oldest thermometers which are given above, it appears that the zero in the later thermometers is placed lower than in the earlier ones. Now if the zero in the earlier ones coincided with that of Römer's, the degrees on them must have been shorter than on the later ones, since there must be the same number of degrees within a shorter limit. In the later thermometers the number for the boiling point was found by dividing the space between zero (chiefly determined by means of a cold mixture) and the freezing point into thirty-two equal parts, and marking equal parts off above the freezing point; since these degrees are longer than the older ones, there must be fewer within the same limit, therefore 212, and not 240, at the fixed point, the boiling point.

Kirstine Meyer.

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[1] Misc. Berol., t. v., 1737, p. 120.

[2] Acta Eruditorum, 1714, p. 381.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

London.—The Board of Studies in Ethnology will be designated in future the "Board of Studies in Anthropology."

Mrs. Norman-Robinson has offered to found a scholarship in craniology and anthropometry, tenable at University College, in memory of the late Dr. R. C. Benington.

The principal of the University (Dr. H. A. Miers) has been elected chairman of the University Press Committee of the Senate.

In addition to the post-graduate course of lectures at University College, London, by Prof. J. A. Fleming, on "The Theory of the Propagation of Electric Currents in Telegraph and Telephone Cables and in Electric Conductors," two other post-graduate courses have been arranged, namely:—(1) "The Ideal Arch, Metal and Masonry, Theory and Design," by Prof. Karl Pearson; (2) "Steam Turbines," by Messrs. W. J. Goudie and E. G. Izod, both beginning on January 21.

Among the advanced courses of scientific lectures for the coming term arranged in connection with the University we notice the following. The lectures are intended for advanced students of the University and others interested in science, and admission to them will be free. A course of ten lectures on the "Evolutionary Aspects of Palæobotany" will be given by Mr. E. A. Newell Arber at University College, at 4.30 p.m., on dates which are published in the *London University Gazette.* Three lectures on "The Geology and Physiography of Arctic Europe" will be given by Prof. E. J. Garwood at University College on Thursdays, at 5 p.m., beginning on February 24. Dr. W. N. Shaw, F.R.S., will give a course of lectures on "Dynamical Meteorology, with Special Reference to the Forecasting of Weather," at the London School of Economics on Fridays, at 5 p.m., beginning on January 21. A course of eight lectures on "The Rate and Conditions of Chemical Change" will be given in the physiological laboratory of the University by Dr. V. H. Veley, F.R.S., on Fridays, at 5 p.m., beginning on January 21. A course of fourteen lectures on "Protozoan Parasites, with Special Reference to those of Man," will be given at the Lister Institute of Preventive Medicine, Chelsea, by Prof. E. A. Minchin, on Mondays and Thursdays, beginning on January 17, at 5 p.m. A course of three lectures on "The Marsipobranchii," by Mr. F. J. Cole, will be given at University College on Mondays, beginning on January 24, at 5 p.m. A course of three lectures on "Amphioxus," by Prof. E. W. MacBride, F.R.S., will be given at the Imperial College of Science and Technology on Mondays, beginning on February 14, at 5 p.m.

According to the Chicago newspapers, plans are in contemplation for giving the University of Chicago the finest physical laboratory in the United States, if not in the world. It is said that before the building is complete it will have cost 200,000*l.* All the money is to be furnished by Mr. Martin Ryerson, president of the board of trustees of the University, who was also the donor of the present Ryerson Laboratory at Chicago University.

A committee, with Mr. C. P. Trevelyan, M.P., Parliamentary Secretary to the Board of Education, as chairman, and Mr. W. R. Barker, of the Board of Education, as secretary, has been appointed by the President of the Board of Education to inquire into the administration of elementary education endowments. The terms of reference are "to inquire into the administration of (*a*) endowments, the income of which is applicable or is applied to or in connection with elementary education, and (*b*) small educational endowments other than the above in rural areas, the application of which to their proper purposes presents special difficulties; and to consider how far under the existing law it is possible to utilise them to the best advantage; and whether any, and, if so, what, changes in the law are desirable in the direction of conferring upon county and other local authorities some powers in respect of such educational endowments or otherwise."

In an article on "Some Problems of Secondary Education," in the current issue of *The School World,* Mr.

W. A. Brockington, director of education for Leicestershire, raises several questions which deserve the earnest consideration of all who desire a complete and duly correlated national system of education. In the first place, there is the problem connected with the differentiation of secondary schools and the differentiation of the curricula in these schools. Then the question as to how to secure an adequate supply of trained teachers in secondary schools is discussed. "It is of no use," says Mr. Brockington, "to palter with the problem of the training of secondary-school teachers." Thirdly, there is the problem as to the length of the secondary-school life. "Public opinion has still to be educated into the general acceptance of the axiom that secondary education begins at the age of ten or eleven, and must be continued until at least the age of sixteen or seventeen; and that, accordingly, the privilege of free secondary education imposes a real obligation of self-sacrifice upon the parent." Commenting upon what should be the character of secondary education in the future, Mr. Brockington maintains that we should preserve what is good in traditional knowledge, and, keeping our schools in living touch with the changing needs of society, make the curriculum of secondary schools an epitome of the experience of the race. All sorts of teaching, if properly imparted, represent culture—science, theoretical and applied, the construction of engines, and manual work.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Dublin Society, December 21, 1909.—Dr. J. M. Purser in the chair.—Prof. W. **Brown**: Permanent steel magnets. With a given quality of steel the dimension-ratio can be found which gives the most effective magnet with a minimum weight of material. Also the results of six months' tests of fourteen different steels show that magnets made of chrome and tungsten steels are the most permanent.—Major F. **Eassie**: Some variations in the skeleton of the domestic horse and their significance. The author states that in whole races of the domestic horse the skeleton gives proof of deterioration from the type of the wild species, and that to a great extent this deterioration exists in horses in every country, and that it is easily recognisable in the living animal. It is due originally to unsuitable environment and breeding from deteriorated stock. As the result of observations of a large series of horses of different races, the author found three main variations in the skeleton, viz. in the relative length of the segments of the head and spine, of the arm, and of the thigh. That the short spine is a primitive character he considers proved by the remains of horses found in recent formations in the valley of the Nerbudda. In the evolution of the horse from its remotest ancestors in the Lower Eocene the arm and the thigh have gradually been shortened, and this shortening has determined its speed. The author also suggests that the short spine, arm, and thigh, respectively, were dominant characters as regards heredity, and that deterioration from the type of the wild species was probably recessive.

PARIS.

Academy of Sciences, December 27.—M. Bouchard in the chair.—The president announced the death of M. Bouquet de la Grye, past-president of the academy, and of M. Lortet.—Emile **Picard**: A class of developments in series of fundamental functions connected with certain functional equations.—M. **de Forcrand**: The hydrates of rubidium and cæsium. Particulars are given of the isolation of $RbOH+H_2O$, $RbOH+2H_2O$, $CsOH+H_2O$. The melting points of these compounds and heats of solution are given.—R. Jarry **Desloges**: The gradual retreat of the southern polar cap of Mars. A reproduction is given of sixteen photographs of the polar cap of Mars at dates between June 23 and October 19.—M. **Coggia**: Observations of comets made at the Observatory of Marseilles with the Eichens 26-cm. equatorial. Data are given for Daniel's and Halley's comets on December 11 and 16.—M. **Borrelly**: Observations of Daniel's comet, 1909*e*, made at the Observatory of Marseilles with the 16-cm. finder. Data given for December 9, 10, and 11. The comet is round, with a nucleus placed eccentrically.—P. **Chofardet**: Observations of the new Daniel's comet, 1909*e*, made at the Observatory of Besançon with the bent equatorial. Data given for December 14, 16, and 18. Comet appeared as a round nebulosity, 30″ to 40″ diameter, with a slight condensation at its centre. Brightness, as a whole, about the twelfth magnitude.—MM. **Montangerand** and **Rossard**: Observations of Halley's comet made at the Observatory of Toulouse with the Brunner-Henry equatorial. Data given for December 4, 8, 14, and 16.—J. **Haag**: Families of Lamé composed of surfaces admitting a plane of variable symmetry.—D. **Pompéiu**: The representation of analytical functions by definite integrals.—Charles **Reignier**: The calculation of the fly-wheels of rolling mills.—L. **Lecornu**: The fly-wheel of motors for flying machines.—E. **Jouguet**: The velocity of waves of shock and of combustion.—Jean **Becquerel**: The influence of a magnetic field on the damping of light vibrations. A discussion of the absorption bands produced in a magnetic field by xenotime and tysonite at the temperature of liquid (−253° C.) and solid hydrogen (−259° C.).—V. **Bournay**: The adsorption of ions.—L. **Houllevigue**: The preparation of thin films by volatilisation in a vacuum. A platinum wire is coated with a layer of the metal to be deposited, and heated to the necessary temperature in a high vacuum. The film is formed on a glass plate kept in rotation near the hot wire. The method has been successfully applied to the production of thin films of platinum, gold, silver, iron, copper, cadmium, zinc, and tin.—G. A. **Hemsalech** and C. **de Watteville**: The yellow, orange, and red regions of the high-temperature flame spectrum of calcium. Measurements are given for the calcium lines produced in the oxy-acetylene flame; it is shown that the spectrum is very similar to that observed by King in the electric furnace at a temperature of about 2800° C.—E. **Briner** and A. **Wroczynski**: Chemical reactions in gases submitted to very high pressures. The decomposition of nitric oxide and the formation of nitrosyl chloride. Pure NO at pressures greater than 250 atmospheres is decomposed into N_2O_3 and N_2. This corresponds to the observed production of nitrosyl chloride by the compression of a mixture of nitric oxide and hydrochloric acid.—L. **Brüninghaus**: The law of maximum phosphorescence: an attempt at a theory.—R. **Boulouch**: A demonstration of the phase rule. A reply to remarks by M. Müller on the same subject.—H. **Baubigny**: The necessity for the exact study of reactions. Reply to a criticism of M. Colson.—Em. **Vigouroux**: The alloys of nickel and copper. A study of the electromotive forces of these alloys does not point to the existence of any definite compounds of these two elements.—Em. **Pozzi-Escot**: The estimation of nitric nitrogen by reduction with amalgamated aluminium. It is claimed for the process described that it possesses advantages both in speed and accuracy over those commonly employed.—Georges **Dupont**: The stereochemical isomerides of hexine-3-diol 2·5, $CH_3.CH(OH).C{\equiv}C{-}CH(OH){-}CH_3$. The two isomers were separated by means of the properties of the dibromides.—M. **Danaila**: The synthesis of 5 : 7 : 5′ : 7′-tetrabromo-indigo and 5 : 7 : 5′ : 7′-tetrachloro-indigo.—Gabriel **Bertrand** and M. **Holderer**: Bellase and the diastatic splitting up of cellose.—L. **Cayeux**: The mineralogical evolution of the primary oolitic iron minerals of France.—J. **Dumont**: The chemical decomposition of rocks. Rocks of different types were submitted to the action of pure water, carbonic acid, dilute hydrochloric acid, and solution of calcium chloride. The rocks were slowly attacked in all these solutions, the amount of material finally coming into solution being very small, and depending upon the state of division of the rock.—Em. **Perrot** and M. **Leprince**: *Adenium Hongkel*, the ordeal poison of the French Soudan. This plant is called *Kidi-Saramé* by the natives. From the aqueous alcoholic extract of the flowers a highly toxic active principle was isolated of the constitution $C_{20}H_{31}O_8$. It was definitely proved to be neither an alkaloid nor a glucoside, and its true nature still remains undetermined.—J. E. **Abelous** and E. **Bardier**: The general physiological effects of urohypotensine. Experimental studies on rabbits and dogs.—A. **Contamin**: The X-rays and cancerous mice. The action of the X-rays is more efficacious when the tissue of the tumour is young; the resorption of a large tumour causes the death of the animal, probably by poisoning.—Cl. **Regaud** and Th. **Nogier**: The complete and definitive sterilisation of the testicles of the rat, without any lesion of the skin, by a single application of X-rays filtered through aluminium.—Fred **Vlès**: The value of muscular striæ from the spectrographic point of view.—Jules **Auclair** and Paul **Braun**: Two cases of Maltese fever probably contracted at Paris. Both cases, which were definitely proved to be true Maltese fever, were probably contracted from handling sheep skins.—M. **Ledentu**: Vascular tumours and aneurisms of the bones.—P. **Bonnier**: The bulbar centres and intestinal diaphylaxy.—B. **Collin**: Some remarks on two new species, *Dendrosomides paguri* and *Podophrya fixa*.—Gabriel **Arthaud**: The salivary spirochætes.—J. **Savornin**: The palæogeographical evolution of Cape Bon and the direction of the folds of the Atlas, considered as the result of two orthogonal orogenic actions.—Em. **de Martonne**: The unequal distribution of glacial erosion in the bed of Alpine glaciers.—E. **Noël**: Tunisian hydrogeology.—Henryk **Arctowski**: The dynamics of climatic variations.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part iii., for 1909, contains the following memoirs communicated to the society:—

July 17.—H. **Bohr**: The summability of Dirichlet series.—D. **Hilbert**: The theory of conformal representation.—D. **Hilbert**: The form of a surface of the fourth order.

July 31.—A. **Coehn** and U. **Raydt**: The quantitative validity of the law of distribution of charge between dielectrics in contact.—C. **Runge**: The determination of position in balloons.—P. **Koebe**: The uniformisation of given analytic curves (iv.).

DIARY OF SOCIETIES.

THURSDAY, JANUARY 6.

RÖNTGEN SOCIETY, at 8.15.—(1) A Comparison between the Skotographic and Electroscopic Effects of certain Animal Substances with the same Effects of Uranium, Thorium, &c.; (2) Retardation of Electroscopic Leak by Means of Recognised Radio-active and other Substances; (3) Masked Radio-activity; (4) Influence of Radio-active and certain other Substances upon the Division of Animal Cells: Dr. W. S. Lazarus-Barlow.

FRIDAY, JANUARY 7.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Application of the Pitot Tube to the Testing of Impulse Water-wheels: W. R. Eckart.—An Account of a Visit to the Power Plant of the Ontario Power Co. at Niagara Falls: C. W. Jordan.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Oil Fuel: D. S. Richardson.

MONDAY, JANUARY 10.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Travels of a Naturalist in South-west Africa: Prof. H. H. W. Pearson.

VICTORIA INSTITUTE, at 4.30.—Modern Conceptions of the Universe: G. F. C. Searle, F.R.S.

TUESDAY, JANUARY 11.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Glare, its Causes and Effects: Dr. J. H. Parsons.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design of Rolling Stock for Smooth-rail Working on Heavy Gradients: F. W. Bach.

WEDNESDAY, JANUARY 12.

GEOLOGICAL SOCIETY, at 8.—The Igneous and Associated Sedimentary Rocks of the Glensaul District (County Galway): C. I. Gardiner and Prof. S. H. Reynolds. With Palæontological Notes by F. R. C. Reed.—The Gneisses and Altered Dacites of the Dandenong District (Victoria), and their Relations to the Dacites and to the Grano-Diorites of the Area: Prof. E. W. Skeats.—Recent Improvements in Rock-section Cutting Apparatus: H. J. Grayson.

THURSDAY, JANUARY 13.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Atomic Weight of Strontium: Sir Edward Thorpe, C.B., F.R.S., and A. G. Francis.—On the Approximate Arithmetical Solution by Finite Differences of Physical Problems involving Differential Equations, with an Application to the Stresses in a Masonry Dam: L. F. Richardson.—On a Method of Determining the Viscosity of Gases, especially those available only in Small Quantities: A. O. Rankine.—Recombination of Ions at Different Temperatures: P. Phillips.—On the Electricity of Rain and Snow: Dr. G. C. Simpson.—On the Polarisation of X-Rays compared with their Power of Exciting High Velocity Kathode Rays: L. Vegard.

MATHEMATICAL SOCIETY, at 5.30.—The Transformations of Coordinates which can be used to transform One Physical Problem into Another: H. Bateman.—On Homogeneous Oscillation: Dr. W. H. Young.—On the Determination of a Semi-continuous Function from a Countable Set of Values: Dr. W. H. and Mrs. Young.—Note on a Former Paper on the Theory of Divergent Series: G. H. Hardy.—On the Expression of a Certain Function by Means of a Series of Polynomials: Dr. H. F. Baker.—On the Double Sixers of a Cubic Surface: Dr. H. F. Baker.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Lord Kelvin's Work in Telegraphy and Navigation (*Second Kelvin Lecture*): Prof. J. A. Ewing, C.B., F.R.S.

FRIDAY, JANUARY 14.

MALACOLOGICAL SOCIETY, at 8.—Note on *Helix desertorum*: Mrs. G. B. Longstaff.—Description of *Thersites* (*Glyptorhagada*) *Hillieri*, n.sp., from Central South Australia: E. A. Smith.—Note on *Athoracophorus Schauinslandi*: Henry Suter.—The Ampullaridæ of the Eastern Hemisphere. Description of New Species of Donovania, Scutellina, Fissurella, and Pisania: G. B. Sowerby.—Marine Mollusca from the Kermadec Islands. Notes on Polyplacophora, chiefly Australasian: T. E. Iredale.—Helicoids from New Guinea and Description of a New Species of Papuina: G. K. Gude.

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THURSDAY, JANUARY 13, 1910.

A JAPANESE PRIEST IN TIBET.

Three Years in Tibet. By The Shramana Ekai Kawaguchi. Pp. xv+719. (Adyar [Madras], Benares and London: Theosophical Publishing Society, 1909.) Price 16*s.* net.

A NEW book on Tibet, offered to "the English-knowing public" by a Japanese priest who acted for a time as physician to the Grand Lama, raises our expectations of finding therein some fresh and interesting views of Tibetan life as seen from the inside. For the author enjoyed the advantage of moving freely behind the scenes, in the palace and in the monastic temples, in intimate relations with the "Living Buddha," and with many of the notabilities of this Old-World State, at a time when it was pursuing the even tenour of its existence, undisturbed by war's alarms.

A perusal of the volume, however, even in this respect, is somewhat disappointing to a European reader. It is a shallow, rambling, and whimsical narrative, from the standpoint of an emotional oriental monk, upon his wanderings on a pilgrimage from shrine to shrine in a land which he knew little about, and over ground mostly described in detail by European writers. Of geographical or scientific data there is positively nothing of any value, and little that is new even in regard to the religion of the country. Nevertheless, the reader who patiently perseveres through much that is trivial and tiresome may pick up some grains of information respecting the life in the great lamaseries.

The personality of the writer himself is quaintly romantic at times. On starting from Japan for Tibet in 1897, on what he tells us was a search for Sanskrit Buddhist books—a search in which he proved wholly unsuccessful—Mr. Kawaguchi, in his Buddhistic zeal, extracted from his friends, as farewell presents, their pledges to abstain from stimulants or tobacco-smoking and from "the brutal business" of catching fish. "About forty persons willingly granted (this) my appeal."

His æsthetic Japanese instinct leads him to break out frequently into a rhapsody or "*uta*" at the sight of some picturesque scene or aspect of nature; though at times he regretfully tells us that "I wished to embody my sentiments in a few verses, but the inspiration would not come." In "the *Dalai* jungle," which is the nearest he can get to the Himalayan "Tarai," where he halted on the way through Nepal to the Tibetan frontier, he heard a tiger roar, on which "an *uta* came to me:—

"The night sleeps still and calm, the moon shines bright,
What ho!—so loud a roar the stillness breaks,
Vibrating—ah! it is a tiger fierce! In ripples rough his roar terrific throws
The surface even of the mountain stream."

The cuckoo's cry for him, instead of being a pleasure, was "awful."

"My sense of loneliness was heightened by the note of the cuckoo, who now and then broke the oppressive silence and an *uta* then came to me thus:—

"In tortuous paths my lonely way now lies
Among rough mountain tracks and scenes all
The rocks and giant trees in silence stood wild
With naught to break the silent depths around
Except the solitary cuckoo's notes
That make the awful silence more profound."

A flock of cranes leads him to fire off the following:—

"Like feathers white the snows fall down and lie
There on the mountain-river's sandy banks;
Ko-Kow, Ko-wow! sounds strange, a melody
I hear—I search around for this strange cry.
In majesty these mountain cranes
I find are proudly strutting—singing thus."

His visionary temperament, indeed, fired by a generous credulity, causes him often to fail in distinguishing fancies from facts. At Sna he heard the voice of a supernatural being calling to him, and again at Sera monastery; and he elsewhere tells us "I was still in an extatic (*sic*) mood." This must have been his mood also when he saw Lhasa and Potala from the track over the "Genpa" (properly Khampa) pass of the Yamdok, the one followed by the Mission, and whence both Lhasa and Potala were certainly invisible. Facts, indeed, are weak points with him throughout. To begin with, even his very first word in the title of his book, "*Three* Years in Tibet" (on the strength of which he absurdly claims for himself a position of greater authority on Tibetan matters than Csoma and Jaeschke, whereas his book shows him to be utterly lacking in scholarship, and even in ordinary knowledge of the language), is falsified by his own proof. On p. 76 he tells us that he crossed the Tibetan frontier for the first time on July 4, 1900; and on pp. 641 and 650 that he finally re-crossed it on emerging from Chumbi on June 14, 1902, thus giving the duration of his entire stay in Tibet as only *one year and* 345 *days* instead of the "*three* years" to which he gratuitously lays claim! This sort of thing is typical of his matter throughout, so that he is not to be taken too seriously. Nor does he allow his ignorance of details to stand in the way of providing precise fictitious ones. He carried no map or any instruments with him, save a small compass registering the cardinal points, yet he devotes a chapter with the heading "22,650 feet above the sea-level" to a description of his sensations in a snowstorm, when he was somewhere on the plateau, he did not know where. It will be news to the Mission force and to the hundreds of men of the convoys who drank the water of the Yamdok Lake at Nagartse, &c., for several months to be told that the water "is poisonous."

He travelled in the guise of a Chinese Buddhist priest, which his Mongoloid face and acquaintance with the Chinese language rendered not difficult for him. What was more important, he posed as a physician, and, endowed with unbounded assurance and luck, acquired such fame by his "cures" that this brought him to the favourable notice of the Grand Lama. "I came to be regarded as a god of medicine," he says, though he naïvely confesses in excuse for his charlatanism that, not having had any regular medical training, "*I know I made a very dangerous doctor, but I was obliged to go on as a pedant domineering over a society of ignoramuses*"—this is very fine, and worthy of being preserved! Fortunately for Mr. Kawaguchi, the Dalai Lama himself became one of those ignoramuses, and conferred on the "doctor" his intimacy and confidence. But Mr. Kawaguchi is strangely silent as to the subjects of those interesting conversations, beyond the bold general statement that

> "I heard and saw much of him (the Grand Lama) and had frequent interviews with him. I judge that he is richer in thoughts political than religious. He seems to fear the British most, and is always thinking how to keep them from Tibet."

Living in constant terror of being robbed explains, perhaps, the low opinion our traveller has formed of his Tibetan co-religionists—so widely different from the experience of sympathetic Western travellers like Rockhill and others. He says:—

> "It is impossible to trust oneself entirely to Tibetans, for honesty is observed only among people who are known to one another, and only so long as actions are done before the public gaze. Social restraints are no sooner removed than the Tibetan is ready for any crime or enormity" (!).

Our pious priest, therefore, was perpetually inventing falsehoods to deceive his interlocutors, and to "lay false scents," as he terms it.

When the secret of his disguise leaked out, that he was not a Chinaman, but a Japanese, he tells us that he made a "bolt" from Lhasa to India, assisted by an "ex-Minister and his nun-wife (*sic*)." As there was no pursuit, however, his excitement on the way was perhaps more imaginary than warranted. Certainly we cannot say that he has brought back to us any information which is new or important.

The get-up of the book is not at all creditable. It is in the poorest Indian style—it was printed in Madras, and looks it. Misprints also abound, and there is no index. The illustrations have been roughly drawn by a draughtsman in Japan in conventional Japanese style, and exhibit little that is characteristic of Tibet.

We leave the book with the feeling that the really interesting things have been left out.

L. A. WADDELL.

CRITICISM IN GEOLOGY.

La Géologie générale. By Prof. Stanislas Meunier. Pp. xii+344. Second edition. (Paris: Félix Alcan, 1909.) Price 6 francs.

Evolution géologique de la Terre et ancienneté de l'Homme. By Alphonse Cels. Pp. viii+248. (Brussels: Lebègue et Cie., 1909.) Price 5 francs.

THE one point common to these two treatises is that both authors look with a certain enthusiasm on the earth as an active living whole. Prof. Meunier claims that his originality consists in this. For forty years he has worked towards the expression of a theory of the earth, in which the guiding idea is that

> "Le globe est un véritable organisme, où des appareils harmonieusement associés poursuivent la réalisation de fonctions dont l'ensemble se traduit par les progrès d'une évolution planétaire sans arrêt."

The rocks of the earth's crust are in a state of continuous transformation; the characters of a stratum belong to all the ages that have passed since the time of its deposition.

To the mind of the geologist in these islands there is nothing very new in the propositions so clearly set forth in the author's "avertissement," and developed in the work. Some of them, such as the mode of production of flint in limestone (p. 104), and the part played by rain in the excavation of valleys (p. 162), deserve emphasising in lecture-rooms where other views may have prevailed. But they seem rather home-truths nowadays, and are, unfortunately, associated in the book with much that has been discarded in the face of cumulative evidence, and with much that must be characterised as exaggeration of a special point of view. Prof. Meunier, for instance, seems to regard oolitic structure as essentially of secondary origin in the rocks in which it occurs (p. 120); he denies, somewhat late in the day, the glacial origin of the Dwyka conglomerate and similar contemporaneous deposits (p. 277); and, while urging that springs and waterfalls tend inevitably to recede, he minimises the excavating action of a river throughout its ordinary course. Even where we are all prepared to follow him, his triumphal progress is accompanied by too much slaying of the slain. Yet here, as in his previous works, his comments on current explanations of phenomena are always well worth reading. The appearance of a river in a valley as the result of the excavation of the floor down to the surface of the permanent water-table is not new to students of English "bournes"; but it gives one food for thought when applied to larger and permanent cases.

The production of a volcano (p. 74) by the faulting up of a hot region over one saturated with water is distinctly fascinating. The essay (pp. 96–103) on "alluvions verticales," including the South African diamond pipes, has novelty, at any rate, in its treatment of the subject. The essay by Montlosier on the erosion of volcanic relics in Auvergne, published in 1788, was well worthy of resuscitation (p. 158), and forms an interesting feature of a chapter in which full justice is also done to Poulett Scrope. Prof. Meunier has always maintained the community of origin of volcanic and plutonic igneous rocks of various ages; but we doubt if the diagram on p. 82 will gratify students of differentiation. Mr. R. A. Daly, to whom igneous rocks are all basic to begin with, will regard it almost with dismay.

Prof. Meunier's remarks on the relics of the latest—and to him the only—ice-age have a Lyellian ring, but will not satisfy the growing school of glacial investigators. While he rightly urges that considerable areas remained free from ice, though others became for a time concealed, he can hardly convince us nowadays that the glacial epoch was a local phenomenon, shifting from place to place under changes of geographical conditions. Twenty years ago many of us may have said the same, particularly if we lived where glacial relics were not abundant. Travel and conference with others have wrought a great change in this respect, and we may venture to think that Prof. Meunier still prefers to remain a critic rather than a field-observer. His volume is a pleasure to read, for he has the happy manner of an essayist; but it is full of pitfalls for the beginner. It contains, moreover, too many misprints, and is not provided with an index.

M. Cels, fortified in his geology by long and numerous quotations from De Launay's "La Science géologique," rejoices as a giant to run his course. He reminds us at all points of the sailor who, hearing for the first time of an essential fact of sacred history, left the meeting-house and knocked down an unoffending Jew. M. Cels has discovered the Huttonian doctrine; for him, as for Prof. Meunier, the world lives and is subject to evolution (p. 29); but he looks in vain (p. 247) for the traces of a beginning or of an end. Consequently, in the light of this great truth, all geologists, and notably the late M. de Lapparent, seem to him but as blind guides. Lamarck and Darwin (p. 39) have deceived enthusiastic men of science by presuming a beginning of life, from which our existing organic structures spread.

The author's devotion to causes now in action (p. 46) is that of a convert won by faith. With the earlier and not the later Lyell, he would lay enormous stress on the imperfection of the record, and would trace man back beyond the "eoliths" of early Eocene times (pp. 202 and 219). With the early Huxley, he would urge that strata containing the same fossil types in different parts of the globe may be separated by great intervals, even of geological time; and he further believes that the similarity of faunas is due to similarity of conditions of environment rather than to any contemporaneity in time. Prof. Meunier dislikes the idea of a general glacial epoch, on the ground that the earth's climates have got steadily colder; how then, he asks, shall we account for the disappearance of an epoch colder than that in which we now live? M. Cels dislikes it because he believes in the shifting of our polar axis (p. 107) and in the sufficiency of this vital earth to manage all its own affairs. Yet it is interesting to find Prof. Meunier employing the same arguments for demolishing the glacial epoch (p. 274 of his work) as M. Cels employs against the idea of successive geological periods marked by faunas in course of evolution.

M. Cels, during his recent reading, has discovered many valuable things, such as the occurrence of true sediments among archæan masses, and the difficulty of finding any relics of the primordial crust—facts pointed out long ago by Sir A. Geikie, but which are here dated back only to 1905. His studies among the modernists throw him, however, more and more towards Hutton, and even towards Pythagoras (p. 232), and his hope is to reform geology altogether. Both these books are out of the common; but neither is quite so stimulating as Reyer's "Prinzipienfragen," which was reviewed in these columns in 1908.

GRENVILLE A. J. COLE.

CHEMICAL PHILOSOPHY.

The Fundamental Principles of Chemistry. An Introduction to all Text-books of Chemistry. By Prof. W. Ostwald. Authorised translation by Harry W. Morse. Pp. xii+349. (London: Longmans, Green and Co., 1909.) Price 7*s.* 6*d.* net.

SINCE the retirement of Prof. Ostwald from the directorship of the Institute of Physical Chemistry in Leipzig, his literary activity appears to have increased, although for many years his output has been phenomenally great. With his departure from the atmosphere of the laboratory, from the sphere of attraction of experimental problems, the philosophic, pedagogic and historical aspects of chemical science have claimed his attention more closely than was possible heretofore.

The present work is essentially philosophical in character. In a sense it is an attempt to work out a system of chemistry without reference to the properties of individual substances, and its chief characteristic consists in a minute analysis of various chemical conceptions, and of the facts of experience from which they are derived.

The range of analysis is indicated by the titles of the separate sections:—Bodies, substances and properties; the three states; mixtures, solutions, and pure substances; change of state and equilibrium; solutions; elements and compounds; the law of combining weights; colligative properties; reaction velocity and equilibrium; isomerism; and, finally, the ions.

At the outset the author takes the view that the conception of matter is unnecessary, and this term is not made use of in the text. The idea that matter is something originally existing, something which is at the basis of all phenomena, and in a sense independent of them, is very widely spread, and any attempt to get rid of the conception will have to show a clear gain in simplicity, so far as derived concepts are concerned, before chemists agree to discard this particular conception. Such gain is not demonstrated, and the author's assertion that matter can be shown to be made up of the simpler concepts weight, mass and volume will doubtless be objected to on the ground that weight is not a conception of a simpler order than matter.

About half the book is taken up by the chapters on solutions and elements and compounds. A good deal seems to be made of the fact that pure substances can be regarded as limiting cases of solutions. Two component systems are subjected to a somewhat laborious analysis, and numerous diagrams are given to illustrate the various types of possible phase combinations. Chief interest attaches, however, to the demonstration that there are two component mixtures and solutions—viz. those which admit of hylotropic transformation—which behave exactly like pure substances in respect of such change. These solutions can, however, be readily differentiated from pure substances, for the hylotropy of the former is limited to certain definite temperatures and pressures, whereas that of the latter extends over considerable ranges of these variables.

The relationships involved in hylotropy are made the basis of the author's conception of the elements, an element being a substance which cannot be transformed into another non-hylotropic substance within the entire range of attainable energy influences. By energy influences are understood any processes carried out without the actual addition of other substances. This statement is, however, scarcely adequate for the sifting out of the chemical elements. It may have been the case before the discovery of the radio-active substances, but the spontaneous disintegration of these obviously represents a non-hylotropic change, and as a consequence these elements do not fall into line.

The discussion of the laws of chemical combination, of colligative properties, and of catalysers is clear and lucid, but does not present any striking novelty.

In the chapter on ions the nature of a salt is examined. To the many definitions of this particular type of chemical individual which have been given, the author adds a new one. According to Ostwald, a salt is a substance which has the properties of a pure substance in the undissolved condition, whilst it exhibits the properties of two different substances when in solution. If in all solvents all salts are ionised or dissociated, this definition is probably sufficient to describe this group of bodies. It is, however, doubtful whether any practical test, based on the definition, could be actually applied to determine whether any particular substance is a salt or not.

In spite of the fact that we may not agree with the author's choice of fundamental concepts, and that certain results to which he is led are not in accordance with actual facts, it cannot be denied that the general treatment of the subject is profoundly interesting, and that the analysis of facts and ideas is conducted with great ingenuity. The subtitle cannot be taken very seriously, for it is too much to expect that the contents of the book can be digested by the future chemist prior to his study of the orthodox text-book. It should, however, appeal to the more mature student, to whom it is confidently recommended.

H. M. D.

OCEANOGRAPHY IN THE NORTH ATLANTIC.

Scientific and Biological Researches in the North Atlantic, conducted by the Author on his Yachts "The Walwin" and "The Silver Belle." By Dr. R. Norris Wolfenden. Pp. vii+234. (London: Rebman, Ltd., 1909.) Price 7s. 6d. net.

IN this work Dr. Wolfenden gives an account of the hydrographic and biological researches carried out on board his yachts, the *Walwin* and *Silver Belle*, from 1899 to 1907. The investigations, begun in the Færöe Channel with the *Walwin* (36 tons), which was replaced in 1902 by the *Silver Belle* (130 tons), were afterwards extended to the Azores and Gibraltar.

Apart from the observations actually recorded, this account is valuable as showing what a large amount of useful scientific work may be carried out on board a sailing yacht of moderate size, the cost of the additional gear necessary being only a small proportion of the original outlay. It will probably be a surprise to many to learn that from a sailing yacht of 130 tons soundings, physical observations, and tow-nettings may be taken at a depth of 1500 fathoms with comparative ease and certainty.

The first sixty pages are occupied by a summary of the various cruises, and give some idea of the inclement weather which may be expected in the North Atlantic even in summer. The work was carried on in spite of considerable difficulties and hardships, and the amount accomplished is very much to the credit of the *Silver Belle* and her crew of Shetlanders. An accompanying chart shows the positions of the stations on each cruise, and also the contour lines of depth of 100 and 2000 fathoms. The 100-fathom line is, however, erroneously drawn outside the Porcupine Bank, off the west coast of Ireland, instead of passing between it and the mainland.

Following the narrative of the cruises, Dr. Wolfenden gives the benefit of his lengthy and somewhat costly experience in the choice and manipulation of fishing engines and physical apparatus. It appears that the taking of water samples and temperatures in deep water can be worked for the most part without mishap even in rough weather, but that a heavy sea prevents the satisfactory use of closing plankton nets. The chief source of danger is the rolling of the ship, which, by slackening the wire, causes it to "kink," and thus prevents the descent of the opening and closing messengers, if it does not result in the loss of both wire and net.

The greater part of the book is occupied by an account, by Dr. H. N. Dickson, of the hydrography of the various cruises. Except in the case of the Færöe Channel, which is dealt with in considerable detail, Dr. Dickson contents himself with pointing out the general conditions of salinity and temperature prevailing over the regions investigated, deferring the further discussion of the results until a longer series of observations has been accumulated. He directs attention, however, to the effect of the highly saline water of the Mediterranean flowing outwards through the Straits of Gibraltar. The section plotted on p. 161 shows clearly how the denser water, pouring over the sill as if over the edge of a waterfall, sinks to a depth of about 600 fathoms, and at that level streams out horizontally in a layer more saline than that above or below it. The influence of this water was noticeable in the high salinities at intermediate depths found off the coast of Portugal in 1904 and 1905, and it will be interesting to learn, when the results are published, whether the plankton taken on these occasions contains any indication of a Mediterranean origin. Dr. Dickson alludes to the probability of this water reaching the English Channel, and emphasises the importance of continued observation. Other points of interest dealt with are the differences of salinity and temperature on the north and south sides of the Porcupine bank, and the accumulation of evidence to show the existence of a cold bottom current flowing southwards over the Wyville-Thomson ridge. A complete series of sections and full tables of the salinities, temperatures, and meteorological observations on each station are given, but a serious omission is the absence from the tables of a column for the depth of water, which can only be ascertained by reference to the narrative of the cruises.

The last forty pages contain an instalment of the biological work accomplished on the cruises. The subjects treated are:—Fishes, by Mr. E. W. L. Holt and Mr. L. W. Byrne; Amphipods and Isopods, with descriptions of two new species, by Mr. W. M. Tattersall; and *Pyrosoma spinosum*, by Mr. G. P. Farran.

The printing, illustrations, and get-up of the book are excellent, and a few misprints and obscurities, chiefly in the earlier pages, do not seriously detract from the value of Dr. Wolfenden's contribution to oceanography. It is to be hoped that we soon may have a second volume dealing further with the large amount of biological material which must have been amassed.

THE CASE FOR EUGENICS.

The Family and the Nation: a Study in Natural Inheritance and Social Responsibility. By W. C. Dampier Whetham, F.R.S., and Catherine Durning Whetham. Pp. viii+233. (London: Longmans, Green and Co., 1909.) Price 7*s.* 6*d.* net.

"THE power of heredity," writes Mr. Whetham, "is an old story; 'family likeness,' 'family characteristics,' 'family temper,' are expressions which convey ideas well known to all men. Yet with amazing inconsistency we have taken little if any account of such knowledge in our conduct, little if any in our theories of social and political life. We have talked and acted as though it were of no account how men were bred, or what classes of the community were reproducing themselves fastest and what declining in number, as long as each individual was enabled by improved conditions to pass his brief lifetime in increased comfort and security."

It is the duty of preachers of eugenics, a duty conscientiously undertaken by the author, to end this state of affairs; to teach our future statesmen what biological factors govern the rise and fall of nations, and to educate public opinion in such a way that, aided by the legislation that will then be possible, it will insist on the more rapid multiplication of the desirable components in our society, and aim at the elimination of the rotten parts which now permeate it. Mr. Whetham's book cannot fail to influence all who read it. He writes with the clearness and vigour which flow from conviction based on clear thinking; and thus, having the facts with him, presents a strong case strongly.

The line of argument adopted is as follows. First, the importance of heredity is insisted on, and the methods by which it is being studied scientifically are described, namely, the analytical method initiated by Mendel and developed by Prof. Bateson and others, and the statistical method originated by Sir Francis Galton and extended by Prof. Karl Pearson.

Many pedigrees are given as instances of inheritance in man, and are illustrated by diagrams like those published in the "Treasury of Human Inheritance," now being produced by the Galton Laboratory. The important question of the relative influence of heredity and environment is referred to, but since there is very little evidence available for discussion, it necessarily receives but scanty treatment. As the author points out, the only quantitative study of the subject yet published is the work of Barrington and Pearson on keenness of vision and defects of eyesight. They found that no measurable relation exists between powers of vision and environment, whereas the influence of heredity is well marked.

Two chapters follow, the one on the inheritance of mental defect, and the other on the inheritance of ability, the latter being based largely on Sir Francis Galton's "Hereditary Genius." The influence of heredity is further shown in an examination of the circumstances causing the rise, fall, or extinction of families, and finally the effect of heredity acting in conjunction with a differential birth-rate is treated very fully.

It is a well-known fact that the birth-rate in Great Britain fell from 36 per 1000 in 1876 to 27 per 1000 in 1907. This in itself may give cause for alarm, but the most serious feature of the fall is that it has not been the same in all classes. If the lowest stratum of society had been affected equally with the higher strata, the 27 per 1000 would have been reduced to a much lower figure. As it is, the lowest stratum is as prolific as before, therefore our birth-rate has become selective. The least valuable portions of the population are selected to contribute a disproportionately large share of the next generation, by the action of the more valuable portions in bringing about at any rate a partial self-elimination.

The author gives historical instances, in which the action of a selective birth-rate produced by various causes has influenced the rise and fall of nations. As an example we may quote the influence of the Dominican and Franciscan monks, of whom the former came to England in 1220, the latter in 1224. Through their preaching and persuasion, the majority of our men of intellect were drawn into the monasteries and thus rendered sterile. Roger Bacon, Adam Marsh, Robert Grosseteste, Dun Scotus, and Occham are but a few names from a host of others. As a result came the stagnation of the fourteenth and fifteenth centuries, which was only ended by the overthrow of the monasteries in the time of Henry VIII. Then followed the "glories of the Elizabethan age," and "a period of scientific and literary activity, which carried England on through the seventeenth century."

In conclusion, we may heartily recommend this book to those who are interested in the study of heredity as affecting human societies. It is no disparagement to say that the arguments used have many points in common with the teaching of Prof. Karl Pearson. To him, as well as to Sir Francis Galton, all those who write on eugenics must owe a debt. E. H. J. S.

INDIAN WOODS AND THEIR USES.

Indian Woods and their Uses. By R. S. Troup. Pp. 273+ccxviii. (Calcutta: Government Printing Office, 1909.) Price 4*s.*

THIS work is the outcome of a gradual development of research on the part of the Indian Forest Department. The foundation of the system now instituted was laid in 1883, when Dr. (now

Sir Wm.) Schlich was Inspector General of Forests. He succeeded in obtaining the sanction of the Government of India and of the Secretary of State for India to the establishment of the working-plan branch of the department. Under the regulations then issued, all working plans had to be submitted to the Inspector General, who examined them and communicated his views on them to local governments. The Imperial Superintendent of Working Plans kept a record of the progress of the work by means of annual returns submitted to him by local authorities. In this way, a great store of statistics was collected, which, according to Sir Wm. Schlich's intentions, were to be made available as the work proceeded. Unfortunately, after his departure from India in 1885, little or nothing was done in this respect for about fifteen years.

A fresh move was commenced about the year 1901, when Mr. R. C. Wroughton, then Inspector General of Forests, conceived the idea of the present Forest Research Institute, which was approved by the Government of India. The installation of the institute was, however, carried out by his successor, Mr. J. Eardley Wilmot. It is stationed at Dehra Dun, and consists of six members, namely :—(1) a president, (2) an imperial superintendent of forest working plans, and sylviculturist, (3) a forest zoologist, (4) a forest botanist, (5) a forest economist, and (6) a forest chemist.

Arrangements were made for the publication of (1) Indian forest records, and (2) Indian forest memoirs. The latter are published as quarto volumes measuring 12¼ inches by 10 inches, this being the size used by the Royal Asiatic Society and the Geological Survey of India.

The volume under review is the first number of the economic product series. It is a stately but very unwieldy volume, of 273 pages text, and 218 pages of appendices. It is divided into part i., the various uses of Indian woods according to the different purposes for which wood is used; and part ii., descriptive list of the chief Indian woods.

The indices are two in number, giving (1) the English and trade names, and (2) vernacular names.

As part i. is divided into thirty-four sections, such as agricultural implements, boat and ship building, coopers' work, furniture, mining timber, ordnance work, railway carriages, sleepers, telegraph poles, tools, toys, wood pulp, &c., it follows that many woods are mentioned under a considerable number of sections.

Part ii. deals with each species under a number of heads, such as natural order, synonyms, English name, vernacular names, habitat, description of tree and wood, weight per cubic foot, strength, and chief uses. Under the last head, all that has been said in part i. is here repeated. The list of woods is arranged alphabetically to facilitate reference. The number of species dealt with is 554, or about 10 per cent. of some 5000 woody species, about half of which are trees. The descriptions are based mainly on those in Gamble's "Manual of Indian Timbers," supplemented by the results of a further examination of many species. To ascertain what proportion the latter bear to the former would require a detailed comparison of the two works.

The appendices are no doubt very useful, but they are contained in Gamble's book in far more concise shape, while they are spread over 218 pages in the work under review. Indeed, there is in the latter quite an inexcusable waste of space, which reduces the usefulness of the index of vernacular names considerably; it might have been condensed to one-quarter the space. We believe the work was compiled for the use of firms. If this is so, why was the information, if wanted at all, not brought out in a handy little booklet instead of in this big quarto volume, which requires a table of its own to spread it out upon? For the shape, however, Mr. Troup is not responsible; that was laid down by official orders, which the author would have done well to resist.

The present is the second work published by Mr. Troup, the first being a volume on Indian forest utilisation. Both are, to a considerable extent, compilations. We admire Mr. Troup's remarkable activity, but we hope that his transfer to the post of imperial working-plans officer and sylviculturist will enable him to devote his energy to more fruitful work. The most urgent need is the study of the sylvicultural bearing of the more important Indian timber trees. Gamble's "Manual of Indian Timbers" gives all that is required regarding timbers and their uses, until other branches of forestry have been brought up to the same level.

OUR BOOK SHELF.

A Survey and Record of Woolwich and West Kent. General editors, C. H. Grinling, T. A. Ingram, and the late B. C. Polkinghorne. Pp. viii+526. (Woolwich: Labour Representation Printing Co., Ltd., 1909.) Price 10*s.* 6*d.*

THE publication of this work, originally intended for the Woolwich Congress (1907) of the South-eastern Union of Scientific Societies, has been delayed owing to alterations found desirable in the original scheme, and to the regretted death of one of the editors and the prolonged ill-health of another. As it now appears, it is a valuable contribution to our knowledge of that portion of Kent bounded by the Thames, the Ravensbourne, the Cray, and the outcrop of the chalk between the two last-named rivers. It is, moreover, an excellent example of the beneficial result of cooperation in scientific work, for here we have brought together, in readily accessible form, records of the work of local scientific societies and isolated naturalists. The result, so far as numerical records are concerned, will doubtless be astonishing to many. From a small corner of Kent, only some fifty to sixty square miles in area, a considerable portion within the London postal district, none beyond what might be regarded as the outer suburban zone, a rich flora and fauna are recorded. Of plants there is a list of more than 2000. The number of animal forms is not summarised, but the records, with citations of localities, occupy just over 200 pages; of Coleoptera or beetles no less than 3264 species are enumerated.

The publication of these records will doubtless, as the authors hope, induce others to contribute additions either to the lists of species or of localities, and thus to secure fuller knowledge of the distribution of the organisms. Rapid changes, due to the incursions of man, are taking place within the area, and in a few years' time the records will have an added value in enabling us to trace actual changes, and also, perhaps, some of the causes determining those changes. Almost everyone interested in natural history makes from time to time observations, of minor importance, perhaps, regarded as isolated facts, but valuable if brought together and studied in relation to those of other observers in the neighbourhood. Not the least service rendered by a volume such as this is that it offers a definite place of record for many a fact which would otherwise probably be lost. We have discussed at some length the biological matters, which occupy about four-fifths of the book. In addition, there is a brief general sketch of the geology, in which, as an instance of interrelation between geology and industry, it may be noted that Woolwich Arsenal is said to owe its establishment to the suitability of the local Thanet sands for iron-moulding. Scientific industries and archæology are other interesting chapters, and there is a concluding note on Woolwich as a centre for photography. The geological section has a very useful bibliography, arranged chronologically. The book is well indexed. W. G. F.

The Flora of the Dutch West Indian Islands. Vol. I., *St. Eustatius, Saba, and St. Martin.* By J. Boldingh. Pp. xii+321. (Leyden: late E. J. Brill, Ltd., 1909.) Price 10*s.*

Considering the comparative proximity of the West Indies and the number of nationalities in possession, there is a lack of systematic botanical information in the shape of local floras, so that Mr. Boldingh renders good service by the publication of his work relating to three of the Dutch possessions. It is based primarily on his own observations and collections, together with the collections of his countrymen, Dr. Suringar, Mrs. van Grol-Meyer, and Dr. Lionarons, totalling in all about 5000 numbers. The systematic enumeration comprises 806 species, of which 674 are regarded as indigenous and 166 are confined to the West Indies. The Leguminosæ is the best represented family, with sixty species; the Gramineæ, Compositæ, Polypodiaceæ, and Euphorbiaceæ follow in the order named. Panicum, Polypodium, and Peperomia are the larger genera. Ipomœa supplies nine species, of which two are limited to the West Indies, and another is recorded only for St. Eustatius. Two other endemic species, *Galactia nummularia* and *Calyptranthes Boldinghii,* have only been collected on St. Martin.

The author follows Eggers in the ecological divisions, and distinguishes littoral, cultivated, dry shrubby or Croton, and tree or Eriodendron types of vegetation. The dry shrubby and tree vegetations are well developed on St. Eustatius; on Saba the cultivated regions and certain ferns are notable; St. Martin is characterised by the extent of the littoral and shrubby vegetations, while forests are scanty. Generally speaking, the flora of St. Martin differs from that of the other two islands, and contains a number of plants represented on islands lying to the north, while the proportion stands the other way with regard to certain plants recorded only from islands lying to the south. The author has rounded off his information with geological and meteorological notes, a list of vernacular names, chiefly English, and maps. The flora bears out the general view that there is no striking difference between the plants of neighbouring islands in the group.

Weather Forecasting by Simple Methods. By F. S. Granger. Pp. xii+121. (Nottingham: Henry B. Saxton, 1909.) Price 2*s.* 6*d.* net.

The aim of the author is to provide the means for a single observer "to answer the question 'When will it rain?' in a simple and intelligible manner" without the aid of instruments except a barometer, this, however, being regarded as optional, and not necessary. The methods recommended are based mainly on observations of the size, thickness, extent, height, colours, and forms of clouds. Different aspects of cumulus, cirrus, and stratus cloud are discussed in relation to the weather to be subsequently expected, and isolated examples taken from the author's observations at Nottingham are quoted.

As the result of a long series of observations by an observer who is evidently interested in the subject, the work may prove useful to local observers, but it is doubtful to what extent some of the conclusions arrived at can be considered general. Thus "visibility" is regarded as a sign of good weather, because this phenomenon occurs at Nottingham only during light easterly breezes. In some districts, however, visibility is frequently associated with winds from some westerly point, and is commonly supposed to be a prognostic of rain.

Although Mr. Granger again tells us that meteorology is not an exact but an observational *science,* he says in the same breath that his book is not written on exact and *scientific* lines. He has described it well. His cloud classification is incomplete, and is not that approved by international agreement. He ascribes the formation of cumulus to an electrical cause, and states that lurid red skies in the morning or evening are due to refraction of light. After using the word "gradient" several times he at length defines it as "the slope between two isobars when on one the barometer is one-tenth of an inch higher than the other," and speaks of a gradient of 300 miles, a gradient of 29·9, a shallow gradient, and a form of gradients. There are many other statements which ought to be modified in the light of recent researches. For example, our knowledge of the conditions in the free atmosphere is not as limited as the author suggests, and surely calculation already enters into the science of forecasting, and must continue to do so to an increasing extent.

The arrangement of the work, especially with regard to marshalling the descriptions under some definite plan and arranging them in chapters with appropriate headings, leaves much to be desired. The present arrangement is almost fortuitous.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

The Invention of the Slide Rule.

I have read with great interest the abstract of the paper on the invention of the slide rule, by Prof. F. Cajori, which appeared in Nature of December 30, 1909. I agree with the author in thinking that the Rev. William Oughtred was the first to suggest that calculations could be made more accurately and rapidly by sliding the edges of logarithmic scales together than by using compasses—the method adopted by Gunter; but Oughtred had a poor opinion of this device, and rightly considered that his circular scale was a great improvement on it. A few years before 1671, Seth Partridge[1] re-discovered the sliding principle, perfected it, and gave an almost complete specification for the slide rule which is used to-day by engineers.

I was fortunate enough recently to come across, in the library of the British Museum, a pamphlet written by Oughtred in reply to an attack make on him by an instrument maker called Delamain. The pamphlet is entitled "To the English Gentrie and all other studious of the Mathematicks, which shall be readers hereof. The just apologie of Wil: Oughtred against the slanderous insimulations of Richard Delamain, in a pamphlet called Grammelogia, or the Mathematicall Ring." The author very forcibly and very successfully rebuts the charges that were made against him. The following gives his opinion on the question of the priority of the discovery of the circles of proportion:—

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[1] "The Description and Use of an Instrument called the Double Scale of Proportion." (London, 1671.)

"The honour of the invention, next to the Lord of Merchiston,[1] and our Master Briggs, belongeth (if I have not been wrongly informed) to Master Gunter who ex-[illegible] their numbers upon a straight line." He then [illegible]bes the advantages gained by sliding two Gunter's scales together, but points out the defects of this primitive method, and so finally leads up to his circular slide rule.

In the "Epistle Dedicatorie" to Forster's "Circles of Proportion" an answer, said to have been given by Oughtred to a question asking him the reason why he had concealed his inventions so long, is quoted:—

"That the true way of art is not by instruments but by Demonstration; and that it is a preposterous course of vulgar Teachers, to begin with instruments and not with sciences, and so instead of Artists to make their Scholers only doers of tricks, and as it were Juglers; to the despite of Art, losse of precious time, and betraying of willing and industrious wits into ignorance and idlenesse."

Possibly another reason was the fear that his parishioners and others might think that he might have been better employed than inventing slide rules. Supporting this latter view is the fact that he published (1633) his "Mathematicall Recreations" under the pseudonym of Henry Van Etten. In this volume occurs the world-famous arithmetical trick, "Think on a number, double it, &c." It is highly probable that he invented it.

I see no reason for doubting Oughtred's word that he used sliding scales in 1618. The date of Wingate's reputed[2] discovery was thus anticipated by six years. A perusal of Partridge's book published in 1671 shows that the method of using compasses with Gunter's scales was the one that was then generally employed in London. In that year Partridge's slide rules were for sale at the shop of Walter Hayes, at the Cross-Daggers in More-Fields, next door to the Popes-Head-Tavern, London.

Personally, I consider that Seth Partridge is the real inventor of the modern 10-inch slide rule.

ALEXANDER RUSSELL.

Faraday House, London, January 5.

The Tercentenary of the Telescope.

THE article on the tercentenary of the telescope, published in NATURE of December 16, 1909, is extremely welcome, not only because of its appositeness in point of date, but because Dr. Dreyer sets in true light the nature of Galileo's claims in connection with the discovery of the telescope. I do not think that it can be denied that Galileo himself makes the claim, for he puts into the title of the "Sidereus Nuncius" the words "nuper a se reperti." Nor can this be brushed aside as merely an elliptical phrase, because it is pretty clear that he left on the minds of the Doge and Senate of Venice the impression that he had invented the instrument with which he showed them the shipping. I deduce this from the decree as given in a footnote by Mr. Fahie on p. 78 of his admirable "Life of Galileo."

Galileo seems to have known nothing about "the secrets of perspective" as suggested in that decree; he describes quite clearly that he did not reason from optics, but from common sense; and his optics were, in point of fact, wrong when he asserted that one lens could not alone act telescopically. It seems clear that he knew nothing about the formation of an image by a lens. I confess that I cannot see that he is entitled in this matter to so much credit as Prof. Turner ascribes to him in a recent article in the *New Quarterly*.

In the matter of the satellites of Jupiter we tread on much more certain ground, since it is now, I believe, generally conceded that Marius, in his "Mundus Jovialis," gives us a genuine account of his own observations. The charge of plagiarism formulated by Galileo, and repeated by nearly all his biographers, is now exploded. (Mr. Fahie does not explicitly charge Marius with plagiarism, but clearly he disbelieves the general truthfulness of the "Mundus Jovialis," a position that, I feel sure, he would abandon if he read what Messrs. Oudemans and Bosscha have written.) Dr. Dreyer says that Marius found the satellites one day later than Galileo, but when the actual records are compared it becomes clear that Galileo was, on the contrary, at least two days behind Marius. From Galileo's account in his Italian MS. notes, reproduced by Prof. Favaro in his national edition, we see that it was on January 11 that he first suspected the three "stars" to be satellites. (The "Sidereus Nuncius" suggests January 10 for the first suspicions.) Thus Galileo saw them as stars on January 7, and as satellites on January 10 or 11. Now Marius saw them as stars some month or so earlier, and on January 8 he discovered their true nature. Thus it is hardly fair to compare the discovery as satellites made by Marius on January 8 with the mere detection as "stars" made by Galileo on January 7. For the fourth satellite Galileo is entitled to the priority.

I dislike as much as anyone all quarrels about priority, and only direct attention to these facts because of Galileo's hostile attitude. His genius and his intuitive perception of the ways of nature will gain for him for ever the admiration of all men, but his arrogance and jealousy in these two matters make it incumbent on us to be much more critical than in ordinary cases, and particularly so because such fair-minded biographers as Mr. Fahie speak of "his right to the first discovery" of the satellites, and everyone uses the phrase "Galilean telescope."

J. A. HARDCASTLE.

The Dial House, Crowthorne.

Cross-fertilisation of Sweet-peas.

UNDER the above heading a writer in NATURE of January 6 (p. 280) refers to "the statement that the sweet-pea is invariably self-fertilised," a statement which he thinks is "often based on an opinion of Charles Darwin's." In refutation of this opinion your correspondent describes the visits of the hive-bee and of Megachile to the flower in question. These same species were seen by Mr. Darwin to visit sweet-pea flowers ("Cross and Self-fertilisation," 1876, p. 156). He goes on to ask how it is that the varieties are not habitually mongrelised, and sums up his discussion in the following words:—"Whatever the cause may be, we may conclude that in England the varieties never or very rarely intercross. But it does not follow from this that they would not be crossed by the aid of other and larger insects in their native country, which in botanical works is said to be the south of Europe and the East Indies. Accordingly I wrote to Prof. Delpino, in Florence, and he informs me 'that it is the fixed opinion of gardeners there that the varieties do intercross, and that they cannot be preserved pure unless they are sown separately.'"

January 10. FRANCIS DARWIN.

MAY it be allowable to point out that "π," who has contributed an interesting note (NATURE, January 6, p. 280) on the "Cross-fertilisation of Sweet-peas," is not the same who (vol. lxxii., p. 631) is responsible for the "Rhymes on the Value of π"?

THE ORIGINAL "π."

A Hardy Goldfish.

CAN one of your readers please explain the following incident?

I keep some goldfish in a glass bowl. On December 31 last one of them was seen lying motionless upon its side on the surface of the water. After about an hour, as it was thought to be dead, it was removed to a shelf, remaining there for three hours. My sister then picked it up to throw it away, but was surprised to find it opening its mouth and breathing. She placed it in fresh water, when at first it lay on its side, occasionally moving its head and fins. The water presently appeared to be slightly tinged with the golden colour of the fish, which suddenly turned over on to its back, the ventral surface being upwards, and remained thus for some time. On being transferred to another vessel, the fish, assuming the normal position, swam about leisurely for a little while, and gradually recovered its usual energy, being now equal to any of its old companions.

Was this a case of paralysis, cramp, or other temporary ailment, and what enabled the fish to remain so long alive out of its natural element? G. C. CONSTABLE.

50 Clonmel Road, South Tottenham, January 4.

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[1] Rather a grandiloquent method of referring to Jhone Neper, 'Fear' of Merchiston.

[2] "Le Calcul Simplifié." By M. d'Ocagne. (1905.)

RECENT WORK IN THE TELEGRAPHIC TRANSMISSION OF PICTURES.

COMMERCIAL photo-telegraphy may be said to have started in November, 1907, when Prof. Arthur Korn installed three of his selenium instruments at the offices of the *Lokal Anzeiger,* in Berlin, *L'Illustration,* in Paris, and the *Daily Mirror,* in London; towards the end of 1908 a further selenium apparatus was installed at Manchester. These early machines depend on the sensitiveness to light of one modification of the element selenium—selenium of the slate-grey form distributed over two platinum coils wound one between the other over a flat rectangular plate of steatite, being termed a selenium cell. Current was passed from a battery through the cell, on which was cast illumination from a Nernst lamp, the rays of which had first to pass through a revolving transparent photographic film, so that the intensity varied each instant according to the density of the photograph. A second cell was illuminated simultaneously by suitable means, the two being connected up on opposite sides of a Wheatstone bridge, so that the current sent to the receiving machine varied as the difference of the reciprocals of the resistance of the two cells. By combining suitable cells the inertia was largely overcome, and a photographic portrait could be transmitted in twelve minutes. The current at the receiving station passed into a string galvanometer, and laterally displaced a small shutter attached to the "strings," this movement cutting off more or less of the light projected from a second Nernst lamp on to a sensitive photographic film revolving synchronously with the transmitting cylinder, and one-quarter its size.

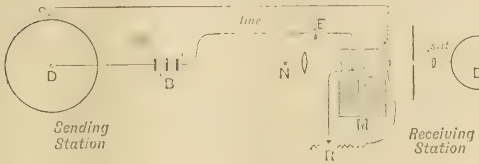

FIG. 1.

The disadvantage of this system is that the current transmitted is so small that when there is much leakage on the line it is difficult to get sufficient movement in the shutter of the galvanometer to give a useable result. The maximum current obtainable at the receiving station is about one milliampere. Prof. Korn's telautograph, which he completed in 1908, was therefore a great advance, as, the resistance of the line and the galvanometer being R and r respectively, the current C is proportional to $E/R+r$; hence by increasing the electromotive force, more current—up to 20 milliampères—can be obtained, and the induction effects from neighbouring lines are very much less pronounced.

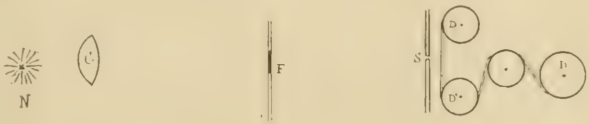

FIG. 2.

The principle of the telautograph of Prof. Korn is seen in diagram form in Fig. 1. Here D is a cylindrical drum about 10 cm. diameter and 12·5 cm. in length, which is revolved at the rate of 30 r.p.m. by a high-speed motor suitably geared down; S is a steel stylus which is mechanically moved laterally at the rate of about 1 cm. in 40 seconds, and thus S traces a spiral path over the drum D. To D is attached a piece of copper foil, on which has been drawn a sketch or copy of a photograph in some insulating ink; more recently a single line half-tone reproduction of a photograph in fish-glue on metal foil has been transmitted with considerable success. B is a battery of thirty to sixty volts, and the telephone line is represented by dotted lines. A condenser is usually shunted across SD to prevent sparking, about one microfarad being necessary. At the receiving station we have a drum D, of ebonite, on which is wrapped a piece of sensitive photographic film or paper, this revolving in a light-tight box, and also moving laterally in corresponding manner to the transmitter. In the front of the box is a lens and small diaphragm, concentrating as a small spot on the film whatever light passes through a fine slit; this slit lies on the optic axis of a condensing lens fixed in front of the Nernst lamp N, the rays of which pass through a hole bored in the pole pieces of a strong electromagnet M, absorbing about 100 watts. A fine flat silver wire is stretched across the magnetic field, as shown in the figure, through which the current received passes; the shadow of this wire, when *no current passes, i.e.* when the stylus S is separated from the metal on D by an insulating line of the picture, just covers the slit, but when the stylus is in contact with the metal, and current flows through the circuit, the wire is displaced, and light therefore falls upon the sensitive film.

If the period of swing of the galvanometer wire nearly coincides with the period n/t of the currents sent from the transmitter—n being the number of lines per centimetre and t the time taken for a point on the circumference of the cylinder to travel 1 centimetre—there is a great tendency for the wire to vibrate intensely and so not respond exactly to the widths of the lines, which widths constitute in effect the tones in the photograph. Also in transmitting a half-tone photograph with n lines per centimetre, there is always a tendency for the wire to swing with a frequency n/t. A very dead-beat effect is, however, obtained by inserting a cell in the line circuit, and shunting a regulating resistance on the galvanometer, as indicated in Fig. 1, and by keeping the moment of inertia of the string to a minimum value.

I have obtained useful photographic records of the movements of a string galvanometer of very small inertia, in the manner shown in Fig. 2. Here the light from a Nernst lamp N is projected through the hole in a string galvanometer, where it is intercepted by the magnesium shutter F attached to the strings; the shadow of the foil covers a slit S (perpendicular to the surface of the paper), and as F moves aside (when current passes through the wires), the effective width of the slit is increased; a revolving sensitive film is actuated by the drums DD, worked by clockwork. The result of transmitting a half-tone photograph, and receiving the same by optical photographic means, is seen in Figs. 3 and 4; an artificial line was used. By means of this apparatus much valuable information has been obtained relative to the effects of capacity and inductance in long cables, some particulars of which I hope to publish shortly; the effect of capacity is to widen the "teeth" and make one run into the next.

FIG. 3. A graduating tint in a half-tone photograph represented as a series of waves of diminishing intensity.

FIG. 4.—Dots of varying size in face of a portrait represented as waves with different maximum ordinates.

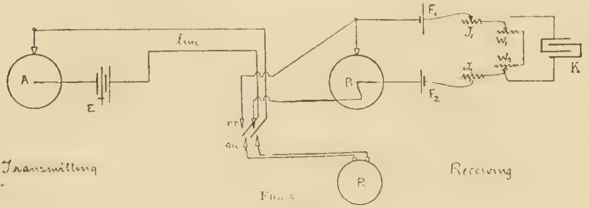

FIG. 5

The telectrograph, which is at present being extensively used for transmitting news photographs from Manchester and Paris to London, is a modification of the Bakewell apparatus, and its essential feature is the balancer or compensator for overcoming the capacity and inductance effects of the line—distortion and "leads" of waves. The apparatus is seen in Fig. 5. Here A is a brass drum to which is attached the half-tone photograph—printed upon lead sheet, and pressed therein so that an even surface is offered to the stylus, which is provided with an iridium point E is the sending battery. The current received flows into two tongues, which are ordinarily in contact with the platinum pins PP, which lead the current to the drum and stylus of the receiver, on the former of which is placed moist absorbent paper containing the necessary chemical matter to give, by electrolysis, a coloured mark when current passes through it. At the end of the revolution, which is finished *before* that of the transmitting cylinder, a metal check arrests further movement, and the motor merely revolves a friction clutch. When the transmitting cylinder has now completed *its* revolution, the tongues being now in contact with the pins QQ, a contrary current is transmitted by means of a reverser, and this passes into the polarised relay R. The relay actuates, through a local battery, a magnetic release which draws away the check, so that the receiving drum starts off again. This means of synchronising is one in frequent commercial use, and was employed by Prof. Korn in his telautograph, and (with slight modification) in his selenium machines.

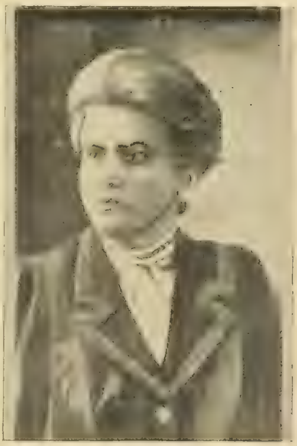

FIG. 6.—Telectrographed from Manchester to London.

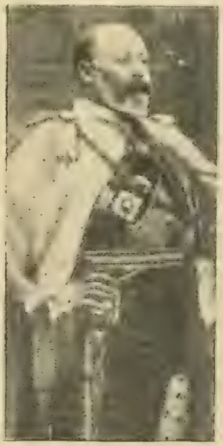

FIG. 7. Telegraphed over artificial line of 2000 Ω by Thorne-Baker telectrograph.

Now if a photograph transmitted as above be received direct on the chemically prepared paper, it would be blurred beyond recognition, owing to the distortion and the secondary discharges due to the line, A small dot would appear elongated as follows:—Where a succession of dots should be received, each one would run into the next, and if at a certain moment the action, after such a series of dots, should cease abruptly—corresponding to a "white" or "high-light" in the photograph—it would, on the contrary, not cease for perhaps a quarter of a second, a tapering chemical line trailing after the last correct mark. The balance as shown in Fig. 5 effectually stops this; two secondary cells, F_1 and F_2, are shunted on to the line through variable inductances, J_1 and J_2, and send a reverse current into the line and variable resistances, W_1 and W_2, while from the sliding contacts of the latter a variable capacity K is fitted. By carefully observing the character of the image on B during the first two or three revolutions, one can at once counteract the line effects by regulation. In the Thorne-Baker telectrograph there are seventy-five turns of the cylinder per inch travel of the stylus, and the cylinder revolves once in two seconds. A result obtained with it over an artificial line (resistance of 2000 Ω) is shown alongside one transmitted from Manchester to London (Figs. 6 and 7). Fig. 8 shows a photograph transmitted by Korn's telautograph from Berlin to Paris, and Fig. 9 a line drawing transmitted by that system over an artificial line of resistance 1000 Ω.

Experiments are at present being made to transmit pictures and photographs by wireless telegraphy, but considerable modification of the ordinary arrangements is necessary, as the number of signals to be sent per second is very much greater than in the case of word telegraphy. The problem is, in fact, comparable with that of wireless telephony, whilst synchronisation has also to be arranged. The later results I have obtained with purely experimental apparatus are sufficiently good technically to show that the problem is one within the limits of commercial practicability.

T. THORNE-BAKER.

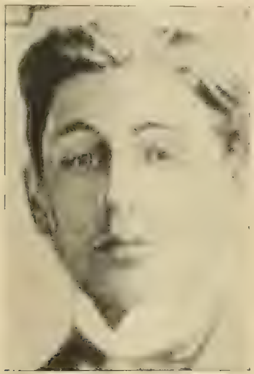

FIG. 8.—Telegraphed from Berlin to Paris by Korn telautograph.

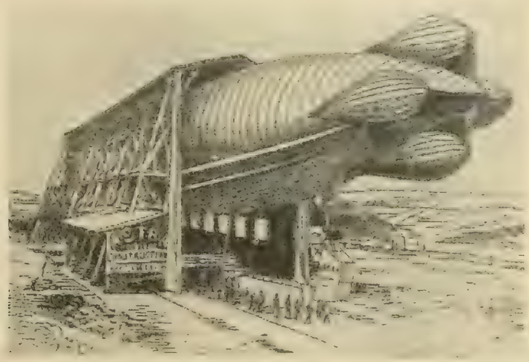

FIG. 9.—Telegraphed over an artificial line of 1000 Ω by Korn telautograph.

SIR CHARLES WILSON.[1]

THE life of Sir Charles Wilson, by his friend Colonel Sir Charles Watson, belongs emphatically to that class of biography which, as Carlyle held, ought to be written. Whether it is destined to be read by any large circle is another question. We might occupy much space in a discussion as to the exact degree of distinction in the subject that justifies a published biography were it not a question that settles itself automatically. We may, at any rate, congratulate the future historians of the Victorian and post-Victorian epochs in that they will have to look for their raw material, not among dusty and almost illegible manuscripts, but plainly set out in fair print and duly classified and catalogued by the librarians. Of such materials as this "Life" will future history be made.

Wilson's career was one of those which are still common in this country, but tend to get rarer and rarer with the advance of democratic ideals, a career devoted to the public service, and of the highest usefulness, unrecognised by, and almost unknown to, the ordinary world of newspaper readers. We might, if inclined to a satirical vein, say that its very obscurity is the best evidence of the value of such a career, seeing that it is often only on some shortcoming, either actual or supposed, that the outside world becomes conscious of the existence of the man in question. Thus in Wilson's case, were it not for the accusations, long since withdrawn as totally unfounded, of a failure on his part to do all that was humanly possibly to relieve Khartum before its capture by the Mahdi, his name would possibly be little known.

Passing over the period of childhood and adolescence and his entry into the Royal Engineers, the first important post that Wilson filled was that of secretary to the British Commission for delimiting the boundary between the United States and Canada from the Lake of the Woods to the Pacific along the 49th parallel of latitude. This line was marked out by astronomical methods, a procedure now known to be liable to the defect that the observations at each station are subject to an unknown error due to the force of local attraction or the deflection of the level. At the present day such a line would be delimited by means of a triangulation. In 1858, however, survey methods had not developed enough for this to be practicable, at all events within any reasonable limit of time, and the only possible course was taken. That the line as then marked out, and as it remains to this day, was not a true parallel of latitude, but a wavy line departing from the truth to distances of some hundreds of feet on either side, was of secondary importance. The urgent point was to get some acceptable boundary laid out upon the ground, and so marked that nobody could have any doubt as to which side of the line they were on at any given moment.

With the technical work of the Commission in the field, Wilson had, however, little to do; his duties were of a more arduous character. The country traversed by the line was in parts almost unknown, and, as regards all the western section, of an extremely wild and mountainous character. The [illegible] were very severe, and the difficulties of travel formidable. In such circumstances it may well be understood that the responsibilities of Wilson's position, being then little more than a boy, entrusted with the duties of commissariat, store and transport officer, were great.

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[1] "The Life of Major-General Sir Charles William Wilson, Royal Engineers, K.C.B., K.C.M.G., F.R.S." By Colonel Sir Charles M. Watson, K.C.M.G. Pp. xv+419. (London: John Murray, 1909.) Price 15s. net.

Jebel Musa.

Jebel Serbal.

The Problem of Mount Sinai. From "The Life of Major-General Sir Charles William Wilson."

Not long after the termination of this commission, he had an opportunity of taking up a work of a somewhat different character, a work which at intervals occupied his energies for a large part of his life—the survey of Palestine and the surrounding regions. It is not the place here to recapitulate, even in briefest summary, the services rendered by him and other officers in this great undertaking; those curious may consult the maps and records of the Palestine Exploration Fund, or may read the account of Wilson's share of it in the work before us.

After his return to England in 1866, and his marriage in 1867, he again went to the East to carry out a special task for the same body, the survey of the Sinaitic Peninsula, with the object of illustrating and elucidating the events of Bible history. Preeminent among the points to be investigated was that of the identification of Mount Sinai, then a disputed question, some authorities contending for a mountain called Jebel Musa, and others for Jebel Serbal. Wilson's party, including, it should be remembered, the late Prof. E. H. Palmer, afterwards murdered by Bedouins in the same country, unanimously came to the conclusion that Jebel Musa was the true Sinai of the Exodus. This view is now generally accepted, and it is this mountain which is pointed out to passengers in mail steamers proceeding southward from Suez. The late Sir Richard Burton, however, always refused to accept it, and maintained that the honour belonged to one of the minor peaks to be found along the pilgrim road from Suez to Akaba.

Wilson's share in the Nile expedition of 1884, and in the attempt to relieve Khartum and rescue Gordon, is dealt with at length. We have already alluded to the abortive attack upon him for a failure in no wise his fault, and it may be fairly conjectured that the author, himself a life-long friend of Gordon, welcomed this opportunity of putting on record his version of the history of that troubled time, especially so in view of the opinion strongly held by him that Lord Cromer, in his "Modern Egypt," was less than fair to Gordon, and gave evidence of a certain want of understanding of his character.

The other work that filled Wilson's busy life we must pass by with slight notice. In 1878 he was appointed to delimit the Turco-Servian frontier, and he afterwards served as Consul-General in Servia. He was for seven years, 1886–94, Director-General of the Ordnance Surveys, a post that he filled with efficiency, though his rule was not marked by any striking advances. From 1895 to 1898, the date of his retirement from the army, he held the office of Director of Military Education. After his retirement he twice again visited Palestine, and in 1901 was elected to the chairmanship of the executive committee of the Palestine Exploration Fund, a position which he held until his death in 1905. He was the recipient of numerous honours, being elected a Fellow of the Royal Society in 1874. The present biography is written in a simple and unpretentious style. It may be cordially recommended to all those to whom the history of the events of which it treats is of interest. The general reader may also find a certain attraction in this account of a man who possessed a personality of rare charm, and, without any commanding intellectual equipment, lived a life of high accomplishment.

E. H. H.

TECHNOLOGICAL SCIENCE IN GERMANY.

WHAT are the chief causes to which the remarkable industrial progress made by Germany in recent years is attributable? This is the question M. E. Leduc sets himself to answer in a paper[1] which, though written primarily for his compatriots, is also of much interest to others.

On the morrow of Jena the outlook in Prussia was sorry indeed. The country was poor, the population sparse; there were no manufactures, and not much commerce. Few roads, and those bad; an ill-equipped postal service; little money, and the kingdom ringed around with tax-offices: such is the picture drawn of the land which lay there bleeding after Napoleon's victory in 1806. Yet now, little more than a century after, the vanquished of Jena have not only ousted their conquerors from the position of military predominance, but are steadily forcing them, and others, from their coigns of vantage on the fields of industry and commerce.

M. Leduc first outlines the earlier steps which led to this industrial advance—the revival of national sentiment, the removal of class barriers and other mediæval restrictions upon freedom—and then deals at length with the two causes which he holds to be the principal factors in the great modern expansion of German commerce, namely, education and cooperation.

By "education" here is meant education in applied science. First, as regards the teacher; the ideal is a man possessing a thorough knowledge of his subject, a teaching aptitude, and a certain quality of industrial practicality. This last is the touchstone. In technological training the aim should be to impart the scientific spirit rather than to let the student lose himself in "pure" science. Otherwise his intellect is apt to become somewhat mummified; and so far as industrial fertility is concerned he presently, college days being over, comes to resemble the fig-tree of scripture, which bore nothing but leaves.

This leaven of practicality is traceable in all the German technical science training. The professors at Charlottenburg are not merely college dons; some, for example, are chiefs of factories, others are the proprietors of commercial laboratories. The students in the technical institutes brew beer, distil spirits, and bake bread, all on a manufacturing scale, and all for sale in the ordinary way of trade.

From the description given it appears that the German instruction in technological science may be broadly classified into four divisions. First, there is the comprehensive training which is to turn out the future captains and leaders of industry. Next, provision is made for putting trustworthy information on technological matters at the disposal of the trading community. Thirdly, central institutions are established where certain industries—*e.g.* brewing, sugar-production—are studied scientifically and practically. Fourthly, there are local technical schools adapted to the special needs of particular localities.

Under the first category comes the famous High School of Technology at Charlottenburg. Here a complete course of instruction in any of the leading branches of technology is obtainable. The scale upon which the institution is equipped may be best shown, perhaps, by the following summary of the professorial staff:—

Section	Professors	Privats-docent
Architecture	21	12
Civil Engineering	13	8
Mechanical Engineering	20	14
Maritime Engineering and Naval Construction	6	1
Chemistry and Metallurgy	15	20
Mathematics and Natural Science	18	15
Foreign Languages	4	—
	97	70

In M. Leduc's opinion, specialisation and the more definitely practical character of the instruction are the points on which the German system shows itself superior to the French. It was all very well a century ago to say "Technical science is one subject; every manufacturer must know it in all its branches or be dubbed incompetent"; but this, like other formulas, has become antiquated, and the world has outgrown it.

Supplementing the tuition in technological science indicated above comes the work of the laboratory at Gross-Lichterfeld. This is a large establishment, covering an area of 10,360 square metres. Its duties are (*a*) to carry out researches, and to make examinations and analyses of materials both for public departments and for the trading community, issuing certificates and valuations based upon the results obtained; and (*b*) to arbitrate, on request of both parties, in matters of litigation concerning the composition and properties of commercial products. In addition, practical instruction in the testing of materials is given to certain students from Charlottenburg; and, as far as circumstances permit, assistance is rendered to persons pursuing special researches. Fixed fees are payable for the services of the laboratory; and the certificates issued are commonly used in commercial transactions as proof of the composition and properties of the articles described upon them. There are six sections, dealing respectively with metals, building materials, paper and textile fabrics, oils, general analytical chemistry, and metallography.

In the third class come the special institutes devoted to various agricultural industries; for example, sugar production, brewing, distilling, milling, and baking. Each of these has its institute, splendidly—nay, lavishly—equipped, not only for the training of students, but for research into any special problem of the industry. One feels, says M. Leduc, speaking of the sugar institute, that money without stint has been given to assemble here everything required for the study of beet-sugar production, and everything is the most perfect of its kind.

Now, in its origin and development this industry is notably a French one, yet Germany has outstripped France in its exploitation, and produces nearly three times as much sugar. Why? Because in Germany the production is organised and unified. "Germany is the land of cartels; jealousy of one's neighbour is unknown. The sugar factories all accept one and the same guidance, namely, that given them by the Institute at Berlin, which is richly endowed by the manufacturers. Prof. Herzfeld, to whom neither money nor help is begrudged, studies for all, and everybody profits thereby."

Similarly in the milling and baking industry, important problems have arisen which could not be authoritatively solved by practical experience only. It was recognised that, as in other industries, the one condition of progress was the founding of an institution devoted solely to the study of cereals, and in which every detail of the questions at issue could be submitted to rigid experimental investigation. Accordingly the required institute was established. It was erected at the expense of the State, but receives subventions from the Chamber of Agriculture, the Society of Millers, and others.

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[1] "L'Organisation syndicale et technique en Allemagne." By M. E. Leduc. (Bulletin de la Société d'Encouragement pour l'Industrie nationale, Octobre, 1909.)

Finally, for the specific assistance of certain local industries, technical schools exist, the particular instances quoted being the professional college of ceramics at Buntzlau and a similar but more restricted institution at Lauban. The instruction here is less generalised than at Charlottenburg, the aim being to impart an artistic and technical education suited to the special requirements of the locality.

As regards cooperation, a good deal is said, but we are only concerned here with its bearing upon technological progress, not with its purely trade aspects. Associations of manufacturers are formed, and if, for example, it is required to carry out some special research, they may give subventions for the purpose to technical colleges or to individual experts; or a commission may be nominated to make experiments; or chemists and engineers may be dispatched abroad to study new processes and new apparatus. Thus even a small manufacturer can keep himself abreast of progress in his department, and researches altogether too costly for single firms can be carried out by spreading the cost over the whole association. As concrete examples may be mentioned (1) the makers of explosives, who maintain an experimental laboratory with firing ground and testing station at an annual cost of 200,000 marks; and (2) the association of Portland cement manufacturers, who, for the reputation of German cement, make stipulations as to quality, and support a laboratory where each member's product is examined to ensure that it conforms to the requirements.

Lack of space forbids us to follow M. Leduc further in his study of this most interesting question, but the keynote of the whole matter is organisation. There is first an intelligent appreciation of the benefits which science can render to industry; next a liberal but carefully-bestowed provision for instruction of her sons in the applications of science; and then, by her organised system of trade syndicates, Germany pushes home the advantage gained through her equally well-organised system of technological education.

C. SIMMONDS.

PLAGUES OF LOCUSTS IN SOUTH AFRICA.

FOR the past three years an organised effort has been made by the Governments of the South African colonies to destroy the swarms of locusts that from time to time invade the cultivated districts and ravage the crops. The third annual report of the Central Locust Bureau has lately been issued under the editorship of Mr. C. P. Lounsbury, the entomologist for the Cape.[1] Together with the two previous reports it furnishes a very instructive demonstration of what can be done by enlightened executives working harmoniously on scientific principles. The Central Bureau comprises representatives of the Cape, Natal, Transvaal, Orange River Colony, Southern Rhodesia, Bechuanaland, Basutoland, Swaziland, Mozambique, and German South-west Africa, its influence thus overstepping political boundaries. It acts by collecting and spreading information about locusts and their migrations throughout the district of its operations, the actual work of repression or extermination being undertaken by the local governments separately.

Two species of locust periodically become serious plagues in South Africa. The red-winged locust (*Cyrtocanthacris septemfasciata*) infests, in various seasons, the east coast districts, migrating in spring and summer, and retiring to the forests in winter. The young locusts are active and most destructive during January and February. No serious invasion of this species was observed in Natal and the neighbouring districts between 1846 and 1893. Whence the migrating swarms come has not been certainly determined, but the Zambezi region is regarded as their probable home. Since 1893 there have been several plagues of this locust in the British colonies, notably in 1907–8, when more than 33,000 swarms were destroyed in Natal. During 1908–9 the insects were by far less numerous; nevertheless, it is computed that a loss of 250,000*l.* from damage to crops was prevented by the exertions of the locust officers.

The brown locust (*Pachytylus sulcicollis*) has its headquarters in the Kalahari Desert, whence swarms migrate into the settled central regions of the South African colonies. The eggs of this species are laid in winter, and are incited to hatch by the influence of the summer rains. Dry conditions lead to postponement of hatching, possibly for a term of more than three years, and such "suspension of animation" is obviously of advantage to a desert-haunting species. Like the red-winged, the brown locust was less numerous and destructive in 1908–9 than in 1907–8, which seems to have been a year of exceptionally severe attack. In March of last year, however, enormous swarms of this species invaded Cape Colony from the north, overspreading an area of 125,000 square miles, so that during the summer of 1909–10 great care and energy will be needed to keep the pests in check.

According to Mr. Lounsbury, no preventive measures can be taken in the "uninhabited and practically waterless wastes" whence the great swarms migrate into the colonies. Attention must be directed to the destruction of the young locusts hatched from the eggs laid by these winged swarms. The young insects during their preparatory stages, while the wings are still undeveloped, are known as "hoppers" or "voetgangers" by the English or Dutch farmers. It is these young locusts that ravage the crops to so terrible an extent, and if the insects be left alone, successive generations may follow each other in the settled districts that are invaded. The farmers, therefore, assisted by the Government, are urged to make war on the "hoppers." Burning grass lands, and poisoning with a sweetened solution of soda arsenite, are the means of combat now in general use. During the locust-campaign of 1907–8, forty-three tons of soda arsenite, ninety-eight tons of sugar, forty tons of treacle, 150 water-tanks, and 5000 pumps were provided, and nearly 12,000*l.* was expended.

In his warfare against the locusts, man finds valuable allies in several species of birds, which pursue the locust swarms, and sometimes well-nigh exterminate them. Kestrels, the "locust bird" (*Glareola melanoptera*), and the white stork are especially active as locust-eaters. It is of great interest to find that two white storks observed devouring locusts in Basutoland in January, 1909, bore leg-rings with inscriptions showing that the birds had migrated from northern Germany in the preceding autumn.

G. H. C.

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[1] Third Annual Report of the Committee of Control of the South African Central Locust Bureau. Edited by Charles P. Lounsbury, Government Entomologist, Cape of Good Hope. (Cape Town, 1909.)

NOTES.

Three British expeditions are likely to be engaged in the exploration of the Antarctic before long. In April last Dr. W. S. Bruce described his plans for a Scottish Antarctic expedition; in September Captain R. F. Scott appealed for support for an expedition which will leave London in July next; and Sir Ernest Shackleton, who has been presented with the Nachtigall gold medal of the Berlin Geographical Society, announced in a speech at Berlin on January 9 that he proposes to begin the preparations for a new expedition when he has completed his work and lectures relating to the achievements of the last expedition. Captain Scott has just received a letter from the Treasury informing him that Parliament will be asked next session to vote a sum of 20,000*l.* towards the cost of his expedition to the South Pole. The sum he asked for in appealing for funds was 40,000*l.*, and the total amount now subscribed and promised is 31,000*l.*, so there should be no difficulty in raising the additional 9000*l.* before the expedition starts. In all probability the amount originally asked for will be considerably exceeded. The expedition will sail in the *Terra Nova*, and the money already subscribed is sufficient to equip the vessel for her voyage. After departing from London the ship will call at Cardiff for coal, and will then proceed south *via* the Cape and Australia and New Zealand, and will leave the last-named place for Antarctic regions early in December. Though the undertaking is described by Captain Scott as "an all-British expedition," it is unfortunate that the announcement of the proposed Government grant of 20,000*l.* has been received with mixed feelings by geographers in Scotland. A circular letter which has reached us from Mr. J. G. Ferrier, secretary of the Scottish Oceanographical Laboratory, Edinburgh, deplores the fact that last November Dr. Bruce was refused a Government grant toward the equipment of an Antarctic expedition then being organised in Scotland, though in the words of Prof. James Geikie, president of the Royal Scottish Geographical Society, "no one is better fitted to carry such an enterprise to a successful conclusion, and the scientific results he has obtained have not been surpassed in interest or importance by the work of any living explorer in high latitudes." While we gladly acknowledge that Dr. Bruce has done splendid work in Antarctic regions with limited means, and regret that Government support for the proposed Scottish expedition has not been forthcoming, we think that in a matter of this kind it is undesirable to appeal to the Scottish public "to stand up for this and other Scottish rights." The claims of an expedition to support from the State for Antarctic exploration must surely be scientific and not political. Because we have confidence in Dr. Bruce's scientific ability and experience we trust that the funds will be provided for the expedition he is organising. Three British expeditions approaching the highest southern latitude from different bases would make for national credit and scientific progress.

The annual general meeting of the Iron and Steel Institute is to be held at the Institution of Civil Engineers, London, on May 4 and 5, and the autumn meeting at Buxton on September 27–29 next. The council of the institute will proceed shortly to award Carnegie research scholarships, and application must be made before February 28. The awards will be announced at the autumn meeting.

A company is being formed in America by Dr. Aaron Aaronsohn, a Turkish agronomist, to investigate the agriculture of Palestine with the view of finding plants that will resist drought in the United States. The inquiries will be carried on through an experiment station at Haifa, which will exchange information with the Department of Agriculture at Washington.

The death is announced at Bayonne, New Jersey, of Mr. William Abner Eddy, in his sixtieth year. In 1890, while engaged as an accountant, he began the aërial experiments which made his name widely known. These included some of the earliest attempts at photography from kites and at measuring by the same means the temperature at various heights. In 1903 he experimented with model aëroplanes dismissed from the lines of kites in mid-air. Mr. Eddy also invented various devices for measuring the tremors of the earth.

The Civil Service Commissioners announce that an open competitive examination for not fewer than three situations as cartographer in the Hydrographic Department of the Admiralty will be held in July next, and that copies of the regulations and syllabus may be obtained at once from the secretary, Civil Service Commission, Burlington Gardens, London, W. Forms of application for admission to the examination will be ready for issue towards the end of January, and will then be obtainable on request, by letter, addressed to the Secretary of the Civil Service Commission.

The opening lecture on January 6 of a course on parasitology, which Prof. R. Blanchard is delivering at the Paris Medical School, was made, the Paris correspondent of the *Times* reports, the occasion of a demonstration of the cordial relations existing between French and British men of science. Prof. Blanchard devoted the lecture to an account of the progress made by British men of science, and especially by the Liverpool School of Medicine, in parasitology and in the treatment of tropical diseases. Since the foundation of the Paris Institute of Colonial Medicine in 1902 through the initiative of Prof. Blanchard, friendly relations have been maintained between it and similar institutions in England and in Brussels, Hamburg, Lisbon, Naples, and Philadelphia. In 1903 pupils of the Paris institute visited the London school under the guidance of Prof. Blanchard, who has been to London and Liverpool several times. Sir Rubert Boyce, professor of pathology in the University of Liverpool, was present, and met with a flattering reception. In expressing his thanks, he dwelt on the importance of the work of Prof. Blanchard and his pupils in furthering the advance of parasitology.

By the death of Colonel George Earl Church, on January 4, science has lost one of the most striking representatives of geographical studies in this country. He was born in Massachusetts, U.S.A., in 1835, and was educated as a civil engineer. In his twenty-third year he took part in a scientific expedition to South America, and was in later life closely associated with that continent. After distinguished service in the American Civil War and the Mexican campaign of 1866–7, he devoted himself to the problem of opening up communication between Bolivia and the Atlantic, and reached the Bolivian plateau by way of the Madeira and Mamore. Having satisfied himself that by the construction of a short line of railway round the cataracts of the Madeira a large area of Brazil and Bolivia would be opened to commerce, he obtained a concession, funds were raised, and work commenced. Unfortunately, as a result of malaria, financial and political intrigues and litigation, it was found impossible to carry out the undertaking, and the ruins of the abandoned railway remained an object of melancholy interest to travellers until in recent years the construction of the line was once more put in hand. After a successful career, during which he was engaged in advising on or carrying into execution important operations in different parts of the world, he took up his residence in this country. He contributed some suggestive papers to the *Geographical Journal*, including one on the physical geography of South America, and as president of the Geographical Section of the British Association delivered an address on the ancient Pampean Sea of the Argentine. He will best be remembered for his contributions to the discussions of the Royal Geographical Society, in which he entertained his audience from his inexhaustible stores of personal reminiscences and historical reading. He served on the council of the society, and held at one time the position of vice-president.

THE first part of the fortieth volume of Gegenbaur's *Morphologisches Jahrbuch* contains an exhaustive treatise, by G. P. Frets, on the lumbo-sacral plexus of monotremes, which will be indispensable to all future students of this extremely variable part of the nervous system. By way of comparison, the author also deals with certain other forms, notably Sphenodon, giving a detailed account of the myology of the hinder extremity in this important type.

THE sixth part of the *Sammlung anatomischer und physiologischer Vorträge und Aufsätze*, edited by Profs. Gaupp and Nagel, consists of an interesting memoir, by Dr. H. Schridde, on "Die ortsfremden Epithelgewebe des Menschen." The author deals with epithelial abnormalities of various kinds, and endeavours to interpret them in a philosophical spirit from the points of view of phylogeny and ontogeny. His observations have thus more than a merely medical interest, although no doubt they will be appreciated mainly by the student of cellular pathology.

THE *Quarterly Journal of Microscopical Science* for December, 1909 (vol. liv., part iii.), contains the third part of Dr. Gordon Hewitt's important memoir on the structure, development, and bionomics of the house-fly. A short account is given of the part played by flies in the dissemination of disease, which we could wish to see republished in a popular form and distributed broadcast. It is difficult to exaggerate the danger to which human beings expose themselves by uncleanly habits in relation to filth, food, and flies, and it is equally difficult to comprehend the indifference which even "educated" people show on this subject—except as the result of gross ignorance and want of observation. The information which Dr. Hewitt has collected with regard to the mutual relations of flies and soldiers in camp, and flies and typhoid patients in hospitals, ought to be sufficient to convince anybody who does not at once set it aside as too nasty for consideration. Unfortunately, the study of nastiness is a necessary preliminary to its removal.

IN view of the renewed interest which has lately been manifested in the difficult problem of the origin of vertebrates, zoologists will welcome Prof. MacBride's contribution to the subject in the *Quarterly Journal of Microscopical Science* (vol. liv., part iii.). Though dealing primarily with the formation of the layers in Amphioxus, this paper includes a discussion of the corresponding processes in the higher vertebrates, with special reference to the views recently expressed by Prof. Hubrecht, with which Dr. MacBride by no means agrees. We must note the addition of two new inmates to the zoological Noah's Ark of imaginary animals, viz. the "Pleuronectid" ancestor of Amphioxus, which, with a number of enormous round holes on its flattened back to represent gill-slits, appears none too well adapted to its environment, and "the common ancestor of Vertebrata, Enteropneusta and Echinodermata," which looks like a mixture between several well-known larval forms. Whatever reception they may accord to these imaginary ancestors, however, most zoologists will probably be grateful to Dr. MacBride for his expressed opinion that, "in starting with Mammalia, and reading their complicated processes into the development of lower Vertebrata, Prof. Hubrecht has read the book of vertebrate development upside down."

A COPY of the Johns Hopkins University Circular, Medical Department, has been sent to us. It corresponds to our calendars or prospectuses, and contains full details of the courses of instruction given, with fees and time-table, and a list of graduates, endowments, publications by graduates, &c. It is published by the University, and can be obtained on application to the registrar.

BULLETINS Nos. 11 and 12 of the Sleeping Sickness Bureau have been issued, and contain full and useful summaries of various papers on trypanosomes and trypanosome diseases, and their agents of transmission. We would suggest that it would be a convenience to readers if the bulletins were issued with cut edges. The director will be glad to receive early copies of authors' papers for notice and for the library of the bureau.

WE have received a reprint of an article by Arthur Macdonald from the *Journal of Inebriety*, Boston, 1909, on the statistics of alcoholism and inebriety, which gives a useful summary for various countries. We are surprised to see it stated that drunkenness in London has risen from 537 to 566 in 1890–5 to 898 in 1904 and 859 in 1905 per 100,000 of population. Certainly the police-court records show the reverse, viz. a decline in drunkenness.

THE Johns Hopkins Hospital Bulletin for December, 1909 (xx., No. 225), contains another contribution on the subject of the ancient medical writers, essays on which have appeared in that journal from time to time. Prof. Eugene Cordell writes on Aretæus, the Cappadocian who lived probably in the second century of the Christian era, about the time of Galen. Many of his works are now lost, but such as remain portray very exactly the symptoms of disease, *e.g.* tetanus, epilepsy, and hysteria. He recognised the "murmur" of heart disease, and treated phthisis by life at sea.

IN a leaflet entitled "A Plan for the Study of Man," by Mr. Arthur Macdonald (from the Proceedings of the Imperial Academy of Sciences, St. Petersburg), an apparatus for the measurement of pain is described. This "temporal algometer" consists of a brass cylinder with a steel rod running through it. The rod is supported by a spring, so that varying pressures from 0 to 4000 grams may be applied, the amount being indicated by an attached scale. The rod has a disc 15 mm. in diameter, and covered with flannel at the end. It is applied over the temporal muscle; as soon as the subject feels the pressure to be in the least disagreeable, the amount of pressure applied is read on the scale.

WE have pleasure in directing attention to the artistically designed "Nature Calendar" published by Messrs. George Philip and Son, Fleet Street, E.C., at the modest price of sixpence. Horticultural notes, observations on the movements of birds, and hints for the collection of Lepidoptera are the features of this year's issue. Special notes for the months refer to varying aspects of the weather in relation to outdoor phenomena and animate nature. The calendar is very suitable for the study and class-rooms where natural science is taught, both for the information supplied and as a suggestion for children to draw up a calendar for themselves.

OWING to the want of agreement between recent investigators of species of Isoetes, any additional information derived from the examination of different species, as the account by Miss A. G. Stokey in the *Botanical Gazette* (April, 1909), is of direct interest to botanists. The anatomy of four American species was investigated. The chief point of originality lies in the interpretation of the so-called "prismatic layers" formed centripetally by the cambium; the author dissents from the explanation, first offered by Russow, that certain of these cells are phlœm elements, but regards the whole of the prismatic layers as secondary xylem. With respect to the phylogenetic position of the genus, the author favours affinity with the Lepidodendreæ, on the ground of morphological characters.

THE identification of the lichens collected during the second Norwegian Arctic Expedition in the *Fram*, 1898 to 1902, chiefly by Mr. H. G. Simmons, was entrusted to Dr. O. V. Darbishire; the results are embodied in Report No. 21 of that expedition, together with a systematic enumeration of all the species—about 500—recorded from the Arctic regions exclusive of Alaska. The material brought on this journey from Ellesmere Land and King Oscar Land yielded more than a thousand specimens, from which 161 different species have been obtained, including the types of eight new to science. The fruticulose lichens play an important part in the vegetation; the various species of Cetraria occur in large quantities over wide areas. It is noted that no specimen of the reindeer moss was collected. The author institutes a comparison between the lichen flora of the Arctic regions, Germany, and the Tyrol to point out that nearly three-fourths of the species are found in the Tyrol and two-thirds in Germany.

THE *Kew Bulletin* (No. 9) opens with an article by Mr. W. J. Bean providing garden notes on some of the newly introduced trees and shrubs collected by Mr. E. H. Wilson in western and central China at elevations ranging from 2500 feet to 10,000 feet. A primary object of Wilson's expeditions was to introduce ornamental horticultural novelties in the shape of arborescent plants that would be hardy in the British Isles. Many of the plants raised from seed have already survived the rigours of more than one English winter. The plants selected for description are almost entirely monotypical genera. Another article by Mr. Bean refers to the Canadian wild rice, *Zizania aquatica*, recommending it for trial as an ornamental plant in ponds and backwaters. It is an annual requiring plenty of sunshine, and it is especially necessary to keep the seeds moist between collection and sowing. Dr. O. Stapf contributes an article on the perennial species, *Zizania latifolia*, which is cultivated in China for use as a vegetable, but cannot be recommended as an ornamental plant.

THE annual report from the Experiment Station, Tortola, Virgin Islands, records a year of steady progress. In the cotton industry the export of lint amounted to 52,528 lb., an increase of 2500 lb. over the preceding year. A lime industry on similar lines to the cotton industry has also been successfully started, the fruit being purchased from peasants at the experimental station. The Agricultural Department not only gives advice and assistance, but forms a direct market for much of the produce raised in the islands.

LUCERNE-GROWING in South Africa has, according to the *Agricultural Journal of the Cape of Good Hope*, recently suffered from a stem-infesting nematode, viz. *Tylenchus dipsaci (devestatrix)*, which has hitherto not appeared in South Africa, although well known in Europe. The adult worm is a fifteenth of an inch long, and produces characteristic distortions and discolorations in the plant. Infested shoots only grow out a few inches; the whole plant languishes and dies in the course of about a year. The infection spreads in a variety of ways, and in time the entire crop is so badly attacked as to be not worth cutting or feeding off. Up to the present no successful means of combating the pest is known.

THE *Agricultural Journal of India*, issued from the Research Institute, Pusa, differs from most of its kind in that it is intended for the intelligent non-technical reader and therefore appeals to a wider class than the more technical memoirs issued from the same institute. One of its most interesting features is the description of native methods of cultivation, management of crops and of stock. In the current issue the Kachin cultivation of tea is dealt with. In other articles an extension of the area under fibre plants is urged, and methods of growing lucerne are described. Mr. Maxwell-Lefroy has a suggestive paper on the cultivation of shellac. The scale-insects of the genus Tachardia, which form shellac as a resinous covering, live on a variety of trees and suck out the sap; they occur to a very great extent in Indian forests, and are, indeed, already cultivated to some extent.

THE reports on the Botanic Station Experiment Plots and Agricultural Education, Antigua, are to hand. There has been a shrinkage in the number of acres planted in cotton in the island to one-third what it was last year, chiefly because of bad seasons and insect pests. Details are given of experiments with sweet potatoes, yams, and other crops. The sugar-cane experiments are carried out on an extensive scale, there being more than 1100 plots of varieties of canes and 256 plots of manurial experiments. Some interesting results are expected from the work on limes and broom-cotton. A new industry, the production of cocoa-nuts, has been started and promises success in certain districts where the conditions are favourable. The report from St. Kitts-Nevis also shows a great amount of activity; the principal industry being sugar production, much attention is given to experiments with the sugar-cane. A good deal of work is being done in cotton, now an established industry in the presidency, and likely to be of considerable economic importance. The report from Grenada deals with cacao, rubber, Sea Island cotton, and other crops. Some interesting experiments are recorded on mulching cacao, but the problem is not yet solved, because of the difficulty of getting plants to grow in the shade of a cacao plantation.

ATTENTION is directed in a recent number of the *Agricultural News* to the fact that about 20 per cent. of the bananas grown in banana-producing countries are unfit for export, and are often completely wasted. Attempts to make a saleable product by drying the fruit and producing banana flour have been only partially successful. Experiments made at the Central Laboratory, Guatemala, described at length in the *Journal d'Agriculture Tropicale*, have shown how to obtain from this waste material a spirit resembling whisky in flavour. The yield of spirit from each bunch of bananas is estimated at 4½ litres, and the cost of manufacture is said to be much less than that of whisky. Over a period of two years the process has proved to be a commercial success. A very similar problem is discussed in the *Journal of Agriculture of South Australia.* The production of raisins has exceeded the local consumption, and as there is no prospect of a successful export trade, some new outlet has to be found. Experiments have therefore been made to ascertain whether raisins could be utilised in satisfying the local demand for strong spirit. Prof. Perkins's results led him to conclude that 150 to 154 gallons of proof spirit might be obtained from a ton of first-grade raisins, and 130 to 134 gallons from a ton of second-grade raisins, and he adds that on this basis raisins should be worth to the grower not much less than 20*l.* a ton.

Bulletin No. 399 issued by the United States Geological Survey contains results of spirit-levelling carried out by the Survey in western Virginia during the years 1896 to 1908, with the cooperation of the West Virginia Geological Survey after 1901. The results have been compiled by Messrs, S. S. Gannett and D. H. Baldwin, and include all previously published data along with the newer observations, re-adjusted and re-arranged by quadrangles. Descriptions and elevations of bench-marks are given for forty-eight counties, furnishing vertical control for nearly half the State.

In a paper published by the Department of Agriculture and Technical Instruction for Ireland (Fisheries, No. 7) Mr. C. M. Cunningham discusses the results of investigations on the drift of the Irish Sea made with floats of various kinds. The floats were distributed by making use of the many steamship lines radiating from Belfast and crossing different parts of the area under examination, and the experiments extend from June, 1903, to May, 1906; the total number of floats distributed was about 1200, and almost exactly half these have been found and the cards returned. The general result suggested is that there is a northward drift throughout the year, modified by a southward tendency during certain states of the weather, especially during the months of March, April, May, and June, when northerly winds are most apt to assert themselves. No instrument distributed north of a line joining Cork Harbour and the Land's End has been found to the south of it.

Mr. D. W. Johnson contributes an interesting study of hanging valleys to the Bulletin of the American Geographical Society. Excluding the types of hanging valleys which are not definitely related to a main stream and its tributaries, as, for example, the valleys left hanging by the encroachment of the sea on south-east England and north-western France, and valleys raised above the level of adjacent plains by up-faulting, the author discusses the questions:—(1) are hanging valleys a trustworthy indication of glacial erosion of the main valley? and (2) may not hanging tributary valleys result from glacial widening of the main valley, instead of from glacial deepening? The investigation goes to show that hanging tributary valleys may be produced independently of glacial erosion, but valleys of this type are of rare occurrence, and that wherever the mouth of a hanging valley has been materially altered to the typical glacial trough form we must infer a greater or less amount of glacial deepening.

From the Survey Department of Egypt we have received a copy of "An Almanac for 1910," compiled at the Offices of that department, and published by the National Printing Department, Cairo, at the price of 25 millièmes (6*d.*). For anyone at all interested in Egyptian affairs this almanac is full of interesting information concerning the various Government departments and services, the railways, telegraphs and population, the meteorological elements and the rise of the Nile at various places, the geographical coordinates of the principal towns, &c. General and scientific matters are also well represented by conversion tables, ephemerides, &c. The ephemeris for Halley's comet is accompanied by figures showing its brightness on different dates and its times of rising and setting. A comprehensive index concludes this cheap and useful work.

An interesting article, by Mr. R. H. Curtis, on the development and standardisation of sunshine recorders appears in *Symons's Meteorological Magazine* for November and December, 1909. The instrument first in use consisted of a hemispherical wooden bowl with hollow glass ball filled with water, invented by Mr. J. F. Campbell about fifty-six years ago, in which the charred wood gave a six-months' record, from solstice to solstice. A regular daily record was first obtained at Greenwich Observatory in 1876 by using a metal bowl, presented by Sir W. Armstrong, and a narrow strip of blackened card. So far as ordinary observers were concerned, there was some difficulty in the adjustment of the card, but this was overcome by Sir G. G. Stokes in 1879, who developed the Campbell-Stokes recorder and cards now in general use; only some trivial additions for adjustment have been made since, one of which is due to Mr. Curtis. Owing to the cost of this instrument, Mr. J. B. Jordan introduced a very ingenious photographic recorder in 1885, but the two forms of instrument do not register precisely the same thing, and after careful comparisons had been made of the results, the Meteorological Office decided to publish only the records of the burning instrument. A report upon the instruments is contained in the Quarterly Journal of the Royal Meteorological Society (vol. xxiv., p. 1), and the specification for the standard instrument has, with slight variation, been printed in the "Observer's Handbook," published by the Meteorological Committee. For obtaining uniformity of results, Mr. Curtis lays great stress upon the necessity of using cards of colour and texture similar to patterns preserved in the Meteorological Office. Other recorders, not in such general use, are not referred to in this article.

Bulletin No. 395 of the U.S. Geological Survey contains an elaborate investigation, by Profs. Schlundt and Moore, of the radio-activity of the thermal waters of Yellowstone National Park. One of the most interesting points brought out is that the travertine of the old terraces contains very little radium as compared with that of more recent formation. The authors interpret this to mean that the hot water has effected a chemical separation between radium and its parent uranium, carrying off and depositing the former only. In course of time the radium in the travertine decays, and is not replaced by a fresh growth, as in normal radio-active minerals. Since some of the travertine is overlain by glacial boulders, this obviously gives a method of dating the Ice age in this district if the accepted rate of decay of radium be assumed and if we suppose that the material discharged by the spring has been of uniform quality throughout the interval. The figure at which the authors arrive is 20,000 years.

The *Physikalische Zeitschrift* for December 15, 1909, contains a paper by Dr. J. J. Kossonogow, of the University of Kiev, on the application of the ultramicroscope to the study of the phenomena of electrolysis. He finds that when an electrolyte is examined under the ultramicroscope, at the moment the current is switched on there appear in the field of view a number of bright points of light which travel towards the electrodes with velocities of the same order of magnitude as have been found for the ions. The path may be deviated by means of a magnet. When a point reaches an electrode it appears to attach itself and take a crystalline form. None of these appearances is observed in the case of a non-electrolyte, and the author considers he has proved beyond the possibility of doubt that the ultramicroscope provides a powerful means of studying directly the motions of the ions in electrolysis.

A separate copy has reached us of Prof. Zeeman's paper on the degree of completeness of the circular polarisation of magnetically divided lines, which was communicated to the Academy of Science of Amsterdam on October 30, 1909. It will be remembered that a luminous gas in a strong magnetic field gives a spectrum which, when viewed along the lines of the field, consists in the simplest case of two lines, which according to Lorentz's elementary theory of their production should be circularly polarised, one right-, the other left-handed. On examination of lines which normal to the field become triplets, quartets, sextets, and nonets, Prof. Zeeman finds that in each case, whether along the field a line becomes a doublet or a quartet, the lines so produced are circularly polarised, and the degree of circular polarisation found approaches more and more to completeness as the intensity of the light transmitted by the instrument increases. The orbits of the electrons in planes perpendicular to the magnetic field are therefore almost exactly circular.

In an article in *Engineering* for December 31, 1909, on the command of the air and its effect on land warfare, some interesting points are dealt with. We may probably quite disregard the idea of balloons being used to drop bombs into towns for the sake of wantonly destroying private property. There are other and more legitimate ways in which the command of the air may probably be the deciding factor in a war. There is the facility it gives for ascertaining an enemy's disposition and movements, and flying machines may be of great use in war by acting on an enemy's communications. There is no reason why such machines should not start from a ship as well as on land, and, if capable of flying 300 miles, would have a striking distance of 150 miles inland from an enemy's coast. At present it looks as if the aëroplane rather than the navigable balloon would become universal, owing to its being faster, quicker at turning, harder to hit, and very much cheaper.

In an article on latter-day developments of the American locomotive in the *Engineering Magazine* for December, 1909, Mr. H. Keith Trask deplores the fact that American locomotive practice has followed rather than led European practice in matters of design relating to increased efficiency from the standpoint of economy. Thus European designers had long considered the advantages offered by superheated steam before the question was seriously taken up in America. Cheap American fuel was responsible for this neglect, but the recent developments of the compound locomotive have rendered the American designers alive to the benefits resulting from the use of superheated steam. As developed for use on American railroads, the superheater is of two types, the smoke-box and the fire-tube. While both types were originally introduced several years ago, it is only within the past twelve or eighteen months that the American railroad world in general has awakened to their possibilities, and they are being applied to many new engines now building for various roads. The Canadian Pacific was the first road to adopt the fire-tube superheater exclusively, and the Santa Fe, although not the first road to test the smoke-box design, was the pioneer in adopting this device as a standard.

One of the chapters in the recent report of the U.S. Commissioner of Education deals with education in Central Europe. Among much other information of interest in this chapter is a reference to the attempt of Prof. Du Bois-Reymond, in his work on inventions and inventors, to prove that inventive productivity in different countries depends on social factors. General education, density of population, transportation facilities, social organisation, and so on, he maintains, determine this productivity, and despite the participation of working men in State affairs comparatively few patent applications come from them. The result of an inquiry made in 1900 shows that in England 15,300 applications for patents were made, or 37 to every 100,000 of inhabitants, and that the percentage of illiteracy was 3·7. In the United States the corresponding numbers were 22,900, 30, and 6·2, the percentage of illiteracy in this case being of the white population above ten years of age. In Germany the numbers were 14,800, 26, and 0·05. In France, however, only 7020 patents were applied for, or 18 per 100,000 inhabitants, the percentage of illiteracy being 4·6. The numbers in Italy, again, were 1030, 3, and 33·8 per cent. of illiteracy. Race characteristics, in other words, do not predetermine the inventive productivity of a country, nor does the high proportion of literates, but social factors, especially the high status of industry, do determine it. England, the United States, and Germany, the countries having the best developed systems of industry, are the most productive in inventions. Germany alone had, in 1900, 1500 patent applications concerning technical contrivances relating to electricity.

Owing to the death of the late Colonel Bingham, editor of the "Fauna of British India," no volume of the series has been issued for some time. This month, however, Mr. Malcolm Burr's half-volume on the earwigs of British India will appear, which is the first monograph on the Dermaptera which has been published since De Borman's monograph in "Das Tierreich." It will contain a description of a number of new and recently established genera, and will be well illustrated.

OUR ASTRONOMICAL COLUMN.

Halley's Comet, 1909*c*.—Some interesting measures of Halley's comet, made with the micrometer of the Yerkes 40-inch refractor, are published by Prof. Barnard in No. 605 of the *Astronomical Journal*. With this large telescope the comet was quite an easy object, and the measures should be good; but, as Prof. Barnard suggests, the edges of such a nebulous body are not easy to set on.

The measures extend up to November 30, 1909, when the estimated magnitude was about 11·0, and the comet showed a condensation of some $7''$ diameter. The diameter of the whole object was $41''$, and possibly an ill-defined nucleus was seen, but this feature was very doubtful. From September 17 to November 14 the measured diameters, reduced to miles, ranged from 16,400 to 9200 miles, the mean being 12,600 miles, or about $1\frac{1}{2}$ times the earth's diameter.

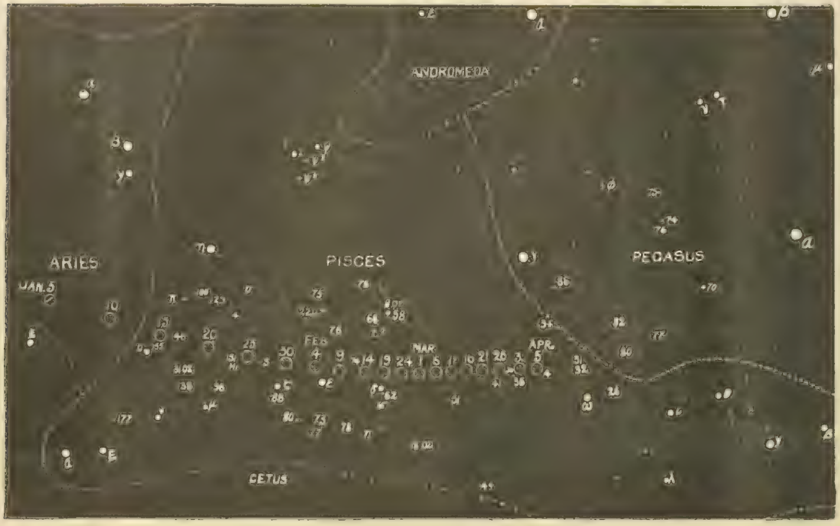
At the December (1909) meeting of the Royal Astronomical Society, reported in No. 418 of the *Observatory*, the Astronomer Royal announced that a photograph secured with the Reynolds reflector at Helwan, on August 24, shows the comet's image; its position agrees within 0·12s. in R.A. and $1{\cdot}7''$ in declination with the position calculated from the Cowell-Crommelin orbit corrected by the Greenwich observations. Messrs. Keeling and Knox-Shaw are to be congratulated heartily upon securing the first known photograph of the comet.

In No. 25 of the *Gazette astronomique*, Signor Pio Emanuelli discusses the probable encounter between the earth and the comet's tail in May next. At 10 a.m. (G.M.T.) on May 18 the comet will pass the descending node of its orbit, whilst the earth will pass the same point ighteen hours later. For an encounter between the tail nd the earth to take place, it is shown to be necessary that the latter should be 22,100,000 km. (13,812,500 miles) long, and that its breadth should be such that it extends, from its axis earthwards, 400,000 km. (250,000 miles).

The accompanying chart shows approximately the nt path of the comet, according to Mr. Crommelin's hemeris, up to April 5.

was re-observed at its returns in 1857, 1870, 1877, 1890, and 1897, but it escaped observation, being unfavourably placed, in 1903.

Mr. Lynn, who gives these particulars in No. 418 of the *Observatory*, also recalls some of the historic occurrences which have coincided with the returns of Halley's comet.



Apparent Path of Halley's Comet, 1910, January 5–April 5.

THE TOTAL SOLAR ECLIPSE OF MAY 8.—From the *Times* of January 5 we learn that Australian observers are already well advanced in their preparations for the observation of the total eclipse of the sun, in Tasmania, on May 8. The conditions of the eclipse—the sun's altitude will be only about 8°—are not sufficiently favourable for the sending of a Government expedition from this country, but the Australian Eclipse Committee is being assisted, by the loan of instruments, &c., by the Joint Eclipse Committee of the Royal, and Royal Astronomical, Societies.

The observations will probably be made from the locality of Port Davey, fourteen hours' journey from Hobart, in difficult country, and a reconnaissance of the district is being arranged for by the Surveyor-General of Tasmania. Messrs. Baracchi, Baldwin, and Merfield are to form the expedition from the Melbourne Observatory, and contingents are expected from the Perth, Sydney, and Adelaide institutions.

Mr. Frank McClean, of Tunbridge Wells, who was so successful at the 1908 eclipse on Flint Island, is about to start for Tasmania, privately, equipped with instruments for photographing the corona and the chromospheric spectrum, &c.

COMETS DUE TO RETURN THIS YEAR.—In addition to Halley's, two other comets are due to pass through perihelion this year. The first is known as Tempel's second periodical comet, discovered in 1873 July 3 at Milan. Its period is about $5\frac{1}{4}$ years, and it was re-observed in 1878, 1894, 1899, and 1904, making its perihelion passage, on last occasion, in November; it should therefore return this coming spring. D'Arrest's comet, discovered in 1851, the second object, and is due to return during the summer of this year. Its period is about $6\frac{1}{2}$ years, and it

OPPOSITIONS OF MARS, AND SIMULTANEOUS DISAPPEARANCES OF JUPITER'S SATELLITES, 1800–1999.—Two useful long-date ephemerides are given by M. Enzo Mora in No. 4379 of the *Astronomische Nachrichten*. The first gives all the dates of the oppositions of Mars between the years 1800 and 1999, the dates of, and the distances and apparent diameters at, perigee, and the relative maximum brilliancy of the planet at each opposition. In the second table are given full particulars of the thirty-six occasions, during the nineteenth and twentieth centuries, on which the four Galilean satellites of Jupiter were, or will be, simultaneously invisible; the next occasion is not until October 21, 1913.

A BRILLIANT FIREBALL.—In No. 418 of the *Observatory* Mr. Denning describes the path of a brilliant fireball which was observed at Harrow and at Bournemouth on November 7, 1909. The true path of this meteor was over Tours and Angers, in France, at a height of from fifty-nine to forty-five miles, and, on the assumption that its radiant was near *e* Tauri, at 58°, +9°, the motion was due east to west. Observations from France, where the meteor must have appeared very bright, are desirable.

ANCIENT IDEAS OF THE PHYSICAL WORLD.—In an article which appears in No. 72 of *La Revue des Idées* (December 15, 1909), M. Leon Jaloustre gives an account of the ideas held by the ancients, at different epochs, anent the physical constitution of the universe. Most of these ideas were, of course, connected with astronomy, and the hypotheses of philosophers from Plato onwards are discussed in a very interesting manner.

MINOR PLANETS.—In *Astronomische Nachrichten*, No. 4380, Dr. Neugebauer continues the list giving the adopted numbers and the orbital elements of minor planets. The present table includes Nos. (661) to (673) inclusive, which were discovered in 1908.

MARINE BIOLOGY AT PORT ERIN.

THE annual report of the Marine Biological Station at Port Erin, Isle of Man, being the twenty-third annual report of the Liverpool Marine Biology Committee, has just been published, and it may be of interest to refer briefly to some of the features of a successful year's work. The station appears to have been more active than ever this last year, and the record of work indicates that researches of a most varied nature have been carried out.

FIG. 1.—The Biological Station at Port Erin

The adjoining fish hatchery (the expenses of which are met by the Isle of Man Fishery Board) has been employed, as usual, in the hatching of plaice eggs, and a total of 7,124,500 larvæ were liberated in the open sea. Some of the eggs have been used for experimental purposes, and a series of extremely good photographs, taken by Dr. F. Ward, and illustrating various stages of the larvæ from the time of hatching until metamorphosis had begun, are included in the report. The number of workers who occupied tables in the laboratory is forty, of whom twenty were senior students of the Liverpool University attending an Easter class in marine biology, which has now become an annual fixture. As a matter of fact, the station is usually crowded during the Easter vacation, and a visitor would be struck immediately by the number of people taking advantage of the laboratory, and by the economical way in which the work is carried out. More than one foreign professor of zoology has been surprised, on learning the finances of the Biological Station, that the place could be kept going with active workers there at all, for it must be remembered that this is not a laboratory subsidised by Government or county council, but depending for the main part of its income upon the voluntary contributions of those interested in the work.

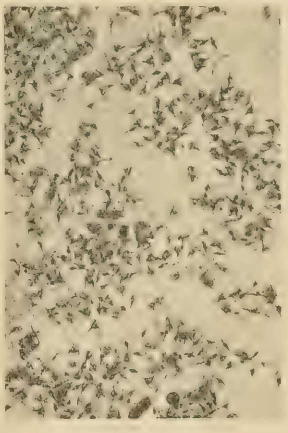


FIG. 2.—Plankton consisting mainly of *Ceratium tripos*.

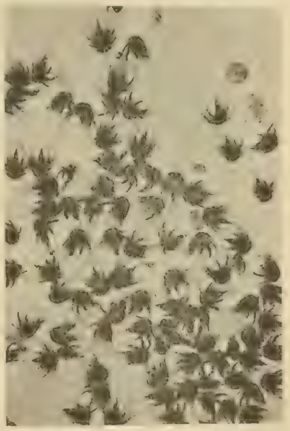


FIG. 3.—Plankton catch consisting almost entirely of *Balanus nauplii*.

In addition to the report of the curator (Mr. Chadwick) are minor reports on some of the research work, including statements of Mr. W. J. Dakin's work on the sense organs of Mollusca, Mr. F. H. Gravely's studies on the polychæte larvæ, and Dr. Roaf's researches on the digestive processes in marine Invertebrata—histological, biochemical, and faunistic work being thus represented. An article by Prof. W. A. Herdman on "Our Food from the Sea" completes the report, and alludes to the scope of the quantitative plankton investigation, which has been one of the features of Port Erin work. The article is illustrated by some photographs of practically pure plankton catches, of which two are reproduced here (Figs. 2 and 3).

No doubt many scientific workers in other branches of zoology who have not considered this quantitative plankton work in detail still hold more or less to Haeckel's view—that time is being lost by using methods which are inaccurate, based upon principles which are impossible. It may be useful, therefore, to consider some of these points here, for a report of this kind brings us up against the question of the practicability and value of quantitative plankton research. During the last few years the number of workers studying the plankton of fresh and salt water has greatly increased, and some of the most remarkable problems in marine biology have been shown to be bound up in plankton questions. I might refer, in the first place, to Pütter, who but a short time ago propounded certain startling theories concerning the food of marine organisms. According to this author the planktonic organisms are insufficient to provide for the wants of many marine animals which can only obtain their food from filtered sea water, and he asserts that the latter is in itself a nutrient fluid.

Many facts, both biological and chemical, have been brought forward against these theories, but, whether correct or not, Pütter has shown the need of further research and the importance of the problem of animal metabolism in the sea. The actual food requirements of the animals must be determined by physiological and biochemical methods, and quantitative plankton methods alone will show whether the plankton can supply the demands made by the physiologist. The total plankton present at any time is the result of a series of processes—productive and destructive—and it is important to know how the volume or quantity varies.

No qualitative work will show the seasonal, or even daily, variation in the volume of the plankton, though it may indicate the specific change. The interest in such problems is immediately aroused when catches with a certain net, after averaging a few cubic centimetres in volume, suddenly rise to 40 cubic centimetres, remain there for a period, and then as suddenly fall to about 1 c.c. or 2 c.c. for the summer season, and this is a characteristic annual change observed in the Irish and Baltic Seas. What determines these changes in volume? When do they occur? Is there a relation between the times of maxima of different groups of plants or animals? We can hardly look to qualitative plankton work for the answers, and it has been the quantitative methods that have mapped out the spring maxima of diatoms and dino-flagellates, and, in opposition to qualitative results, have shown how in temperate and arctic regions the plankton is greater in volume than in the tropics.

Again, in order to show whether the changes in the plankton are due to inherent qualities in the organisms, to external influential hydrographical conditions, or to both, a combination of hydrographic and planktonic work is required. It is, I think, obvious that there are many problems awaiting solution, and our choice is limited to the alternative of either leaving them alone or adopting quantitative methods.

It has been said that the latter are inaccurate. Of course they are, to a certain extent, but unfortunately we have no better at our disposal, and have considered it better to use the most accurate methods possible, and to remember the error when drawing our conclusions, than to leave the whole question alone. It is significant that all the objections, backed by scientific evidence, which have been brought against the quantitative methods have come from investigators using these methods. It is obvious, therefore, that their eyes are open to the defects of the methods and the limits of the apparatus used. In this respect may be mentioned the work of Lohmann and Kofoid on the catching power of the nets (Fig. 4), and of Herdman in regard to the variations in uniformity in the distribution of the plankton, which question was the first to be considered in the Port Erin work. I cannot do better than quote certain lines from the article in the report referred to:—"With the object of formulating such views as to the nature of the Plankton at any particular time, and as to the changes, both diurnal and seasonal, and the determining factors of such changes, we must endeavour to make quantitative catches as accurately and as frequently as possible, so that our samples may be as nearly representative and as nearly comparable one with another as the difficult conditions will admit. These catches should be made with standard nets, should be preserved and measured according to a uniform system, and may then be compared in bulk; but, in addition, the more important organisms should be counted approximately, and the results in round numbers may be used in comparing catches or tracing changes; but such figures should not be made the basis of calculations as to the total numbers of such organisms in the oceans." The last sentence cannot be too strongly emphasised; the quantitative method is *not* used with the object of determining the number of diatoms in the Irish Sea, and *comparisons* of figures obtained in a uniform way should be the feature of the system.

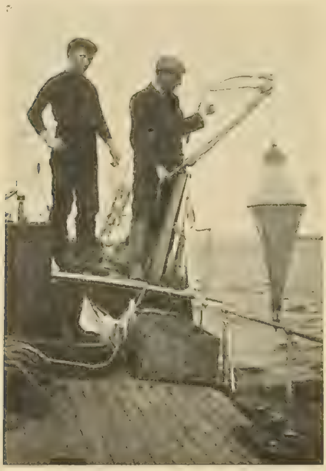


FIG. 4.—The Closing Petersen-Hensen Net going down open.

It would be of great value if some system could be arranged so that plankton catches made in a uniform manner could be taken in different parts of the Irish Sea and St. George's Channel simultaneously. This would greatly help in mapping out the distribution of the plankton and tracing the course of the maxima. For example, in July last, after weeks' of catches containing a normal and small number of various copepoda, echinoderm larvæ, &c., the nets one day were found to contain large masses of *Calanus helgolandicus*. The catches were almost pure, and, in fact, practically useless for the echinoderm larvæ that were wanted. This condition of affairs lasted from two to three days, and then the Calanus swarm disappeared as mysteriously as it came. Systematic and simultaneous catches in the Irish Sea would have shown over what area this Calanus swarm extended, and perhaps whence it came.

W. J. DAKIN.

PRIZES PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1911.

GEOMETRY.—The Francœur prize (1000 francs), for discoveries or works useful to the progress of pure or applied mathematics; the Bordin prize (3000 francs), for improving at an important point the theory of triple systems of orthogonal surfaces; the Poncelet prize (2000 francs), for work in applied mathematics.

Mechanics.—A Montyon prize (700 francs), for the invention or improvement of instruments useful to the progress of agriculture, the mechanical arts or sciences; the Vaillant prize (4000 francs); the subject for 1909, postponed to 1911, is to improve the application of the principles of the dynamics of fluids to the theory of the helix, and the question proposed for 1911 is to perfect at some point the study of the motion of an ellipsoid in an indefinite liquid, having regard to the viscosity of the liquid.

Navigation.—The extraordinary prize of 6000 francs, for work tending to increase the efficiency of the French naval forces; the Plumey prize (4000 francs), for improvements in steam engines or for any other invention which would contribute to the progress of steam navigation.

Astronomy.—The Lalande prize (540 francs), for the most interesting observation, memoir, or work useful to the progress of astronomy; the Valz prize (460 francs), for the most interesting astronomical observation made during the current year; the G. de Pontécoulant prize (700 francs); the Damoiseau prize (2000 francs), subject postponed from 1909, the theory of the planet Eros based on known observations, and for 1911, to perfect the "Tables de Jupiter" of Le Verrier.

Geography.—The Tchihatchef prize (3000 francs), for a recompense or encouragement for exploration of the unexplored or partially explored portions of Asia; the Gay prize (1500 francs), for the study of a French African colony from the geological point of view (Algeria and Tunis excepted).

Physics.—The Hébert prize (1000 francs), for a discovery in applied electricity; the Hughes prize (2500 francs), for a discovery or work contributing to the progress of physics; the Gaston Planté prize (3000 francs), for an important invention, discovery, or work in the field of electricity.

Chemistry.—The Jecker prize (10,000 francs), for work in organic chemistry; the Cahours prize (3000 francs), for the assistance of young chemists already known by their original chemical researches; Montyon prizes (unhealthy trades) (2500 francs and a mention of 1500 francs), for a discovery of a means of rendering an art or trade less unhealthy.

Mineralogy and Geology.—The Delesse prize (1400 francs); the Joseph Labbé prize (1000 francs), for geological works or researches leading to effective development of the mining wealth of France, its colonies or protectorates; Fontannes prize (2000 francs), to the author of the best palæontological publication.

Botany.—The Desmazières prize (1600 francs), for a publication on cryptogams; the Montagne prize (1500 francs), for important works bearing on the anatomy, physiology, development, or description of the lower cryptogams; the de Coincy prize (900 francs), for a work on phanerogams; the Thoré prize (200 francs), for the best work on the cellular cryptogams of Europe.

Anatomy and Zoology.—The Savigny prize (1500 francs), for the assistance of young travelling zoologists, not in receipt of Government assistance, who occupy themselves more especially with the invertebrates of Egypt and Syria; Grand prize of the physical sciences (3000 francs), for the morphogenic study of the characters of adaptation to tree life in the vertebrates; the Cuvier prize (1500 francs), for a work on zoological palæontology, comparative anatomy, or zoology.

Medicine and Surgery.—Montyon prize (2500 francs, mention of 1500 francs); the Barbier prize (2000 francs), for a valuable discovery in surgical, medical, or pharmaceutical science, or in botany in its relation to medicine; the Bréant prize (100,000 francs), for discovering a cure for Asiatic cholera, or by discovering and removing its cause; the Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; the Baron Larrey prize (750 francs), for an army or navy surgeon or physician for the best work dealing with the subject of military medicine, surgery, or hygiene; the Bellion prize (1400 francs); the Mège prize (10,000 francs); the Chaussier prize (10,000 francs), for the best book or memoir on practical or forensic medicine.

Physiology.—A Montyon prize (750 francs), for experimental physiology; the Philipeaux prize (900 francs); the Lallemand prize (1800 francs), for the encouragement of work on the nervous system; the Pourat prize (1000 francs), for a memoir on the origin of the antiferments (postponed from 1909), and (1911) for a memoir on the influence of the mineral elements, especially of calcium, on the activity of the digestive diastases.

Statistics.—A Montyon prize (1000 francs, a mention of 500 francs).

History of Science.—The Binoux prize (2000 francs).

General Prizes.—The Arago, Lavoisier, and Berthelot medals; the Gegner prize (3800 francs); the Lannelongue prize (2000 francs); the Trémont prize (1100 francs); the Wilde prize (one of 4000 francs or two of 2000 francs), for discoveries in astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; the Lonchampt prize (4000 francs); the Saintour prize (3000 francs), for work in mathematics; the Victor Raulin prize (1500 francs), for assisting the publication of works in geology and palæontology; the prize founded by Mme. la Marquise de Laplace; the Félix Rivot prize (2500 francs); the Pierson-Perrin prize (5000 francs), for a discovery in mechanics or physics; the Serres prize (7500 francs), for works on general embryology applied to physiology and medicine; the Jean Reynaud prize (10,000 francs), for an original scientific work; the Petit d'Ormoy prize (two prizes of 10,000 francs), one for work in pure and applied mathematics, and one for natural science; the Baron de Joest prize (2000 francs).

LONDON COUNTY COUNCIL CONFERENCE OF TEACHERS.

SIX addresses were given from the chair and twenty papers were read at the meetings held on January 6, 7, and 8 at the Birkbeck College. As a rule, the gatherings were large, and the papers read were of considerable importance. We understand that the London County Council will publish and distribute a complete report with the same liberality as in former years.

The subjects of the papers were classed under the headings:—(1) organisation of higher schools; (2) training of engineers; (3) teaching of number; (4) teaching of domestic economy; (5) methods of teaching in schools for the mentally defective; (6) educational experiments in schools. With so varied a programme it is not easy to point to any single idea as dominant in the papers or in the discussions which followed. Nevertheless, it is safe to say that there was a continued endeavour, consciously in some cases and unconsciously in the remainder, to bring the work within the school walls into closer relation with the present and future activities of the pupils in their daily lives.

The main impression produced by the conference as a whole—an impression which could hardly escape the notice of any reflective observer—was that the London education authority is acting with wise foresight in encouraging initiative and individuality among its teachers. One cannot, of course, assume that such encouragement is given in every school simply on the evidence of these meetings, but there is no doubt that men of originality and proved competence are encouraged and helped to put into practice new ideas and new methods, and that this is true for the older as well as the newer subjects of the curriculum. It is not easy to overrate the importance of the attitude of the London Education Committee and its official advisers with regard to this treatment of the teacher. Whether we approve or not, for good or for ill, the growing municipalisation of education in this country is an irresistible fact.

That the administration should be municipalised is probably a benefit; we may agree with Mr. Cyril Cobb (who opened the conference) in his view that the union of education with other municipal work was good, both for education and the other municipal departments which were brought into touch with it. The danger—and it is a grave one—is that the teachers may become bureaucratised—that they may sacrifice the finer elements of professional spirit to the attainment of smooth and trustworthy working as components of the municipal machine. If English schools are to continue to deserve their reputation for training character it can only be by retaining the requisite spirit in the teachers. From these considerations we may regard the tone of these conferences as promising well for the future of London education. With thankfulness we recognise that the London County Council is anticipating the dangers which are liable to accrue from the very efficiency of its system, and is inhibiting their growth by promoting the development of initiative and of independent professional criticism among the teachers in the London service.

Organisation of Higher Schools.

Turning to the headings given above, under (1) Mrs. Millington discussed the aims of the new Central Schools for Girls, for which the age of entry is eleven to twelve and of leaving fifteen to sixteen. Girls needed both fitness to take charge of a home and fitness for commercial or industrial employment. Training for home-making should be given to all girls alike; for this purpose a small house, a day-nursery, and a small garden should be attached to the schools. Poetry, music, and one foreign language were among the essentials. Mr. H. J. Spenser, headmaster of University College School, read a paper on the organisation of a large secondary school, in the course of which he said that, as compared with other nations, we suffered from lack of expert knowledge in our rulers. Abroad, the men who controlled national systems were men who had spent most of their lives in teaching. We pay a heavy price for amateur government. The greatest national need to-day is the need for efficiency in the secondary schools.

Training of Engineers.

The discussion on the training of engineers took place under the presidency of Sir William White, who advocated a preliminary practical training interposed between the secondary school and the technical college. It was during that period that the boy learned most from the workman, and in Germany they had gone back to that system. After Dr. Walmsley had described the "sandwich" system of training as practised by engineering students of the Northampton Polytechnic Institute at Clerkenwell, a paper was read by Prof. D. S. Capper, in which the author reviewed the whole subject. He divided an engineer's training into (1) school training; (2) scientific training; (3) technical training; (4) subsequent training. As regards (1), he deprecated specialisation, advocated freehand and mechanical drawing, and limited the usefulness of school workshops to teaching a boy to use his tools, to think in the solid and to realise methods of simple construction.

Study of literature and history should balance the work in mathematics, physics, and chemistry. Modern methods of teaching mathematics in schools had produced a great improvement. After school, the factory or office training should extend over two or three years. Should a year of it be interposed between school and college, and the remainder be completed after college? Or should the summer of each year be spent in the factory and the winter in college? Twenty years' experience had shown him that the answer depended on the individual temperament of the student. The college course should lead to a science degree, and the technical diploma should be granted, not by the university, but by a professional body qualified to judge technical training. This training must be carried out on its "clinical" side on a commercial scale and amid commercial surroundings. With reference to the London matriculation, he pleaded for a simplification of the "English" paper and for the introduction of trigonometry in the syllabus for elementary mathematics. At whatever branch of engineering the students were aiming, they should acquire some knowledge of machinery and machine processes, and also some familiarity with the applications of electricity—for engineering practice, not for passing an examination. Specialised professional subjects, *e.g.* bridge building, should be treated at the post-graduate stage.

Domestic Economy.

Mr. J. Wilson (Battersea Polytechnic) delivered an address on the correlation between the teaching of domestic economy and experimental science. The practical problems are how to link the chemistry and physics to the domestic subjects, and how to teach the latter, so far as possible, as applied science. Should the experimental science and the domestic subjects be fused together into one subject? After an experience of ten years at Battersea, the lecturer gave it as his opinion that they should remain two distinct but correlated branches of study. At present the proper teaching of the science subjects on the one hand, and the domestic subjects on the other, demands a specialist mistress for each group. There must be frequent consultation between the two teachers to ensure proper coordination. The principles to be followed were illustrated by detailed discussion of the following typical course for a girls' secondary school (some nature-study should precede the course):—

	Science	Household Work
First year.	Physical measurements. Heat. Chemistry of air.	Needlework.
Second year.	Water and Solution. Acids, alkalis, &c. Chalk, lime. Derivatives of common acids.	Cleaning materials. Elementary principles of cookery.
Third year.	Chemical change; outlines of theory. Flame, washing soda, borax, sugar, alcohol, vinegar, oils and fats, soap.	More advanced cookery and needlework.
Fourth year.	Classification of food-stuffs. Starch, flour and cereals. Milk, butter, cheese, eggs. Meat, meat extracts. Vegetables. Tea, coffee, cocoa.	Cookery; potatoes, rice, bread, cakes, puddings. Soup; cooking meat.
Fifth year.	Digestion: dietetics, dietary scales. Heat values. Elementary bacteriology (air, water, milk, dust). Preservation of foods. Laundry; textile fibres; bleaching; examination of soaps; dry cleaning.	Experimental cookery (an adaptation of "research in household processes.") Laundry work.

Generally speaking, the girls feel that the work is of direct value to them, and the course proves to be as truly educational as the older courses of systematic chemistry and physics, although the problems studied are much more complex. With the present regulations for matriculation, girls who enter for this examination cannot take the fourth or fifth year's course. Mr. Wilson suggested that the London University and the Joint Scholarships Board should add a suitable syllabus which would allow candidates to follow such a course as the one outlined.

Sir Lauder Brunton, who presided, and the Hon. Mrs. Bertrand Russell, dealt with the social aspect of the subject, and it was pointed out that the comfort, health, and sobriety of the nation depended to a great extent on efficient and widespread teaching of domestic economy.

Other Subjects.

The initiated are aware that the teaching of number is of far greater importance than is generally supposed, and will learn without surprise that a whole session was devoted to that topic. Mr. T. Raymont (Goldsmiths' College) opened with an exposition of fundamental principles. The fifth meeting was devoted to problems connected with mentally defective children, and there was a small exhibition of work accomplished, which served to illustrate the methods of teaching in some of the council's special schools.

The final meeting was in many respects the most important and encouraging of the series organised by Dr. Kimmins. Under the title "Educational Experiments in Schools" was given the clearest evidence of the abilities of the teachers and of the opportunities afforded them to develop their ideas. Mr. E. White, handicraft instructor at Essendine Road, gave a lucid account of the manner in which the work of his handicraft centre had been coordinated with that of the schools connected therewith. A sound start was made by bringing the class-teachers into closer relation with the instructor. The council's inspectors and H.M. inspectors gave help, with the result that arithmetic, nature-study, science, and in a lesser degree composition, geography, and history, were all benefited by the connection established between these subjects and the manual work. Mr. J. S. Fowler showed how to treat "weather study" so that its real importance and interest were grasped by boys, and Mr. A. Beaver dealt in a practical way with local history. Miss C. von Wyss gave much-needed advice upon the care of animals in schools. Teachers who wish to keep their furred, feathered, or finned pets in good health should read this paper in the coming report. Incidentally, they will, it is to be hoped, both imbibe themselves and infuse into their pupils that spirit which prompts "courtesy to tadpoles."

G. F. D.

ELECTRIC VALVES.

NOW that the use of higher voltages for bulk supply is becoming more general in this country, the question of protection of electrical plant against damage due to resonance surges in underground lines and atmospheric disturbances as well as in overhead lines—which for commercial reasons are likely to become more common in the near future—is one that electrical engineers should turn their attention to at the present time.

Where trouble has already occurred in central stations it has generally been put down to faulty design or bad insulation of the machines. There is no doubt, however, that the damage is caused very often by the setting up—owing to a short circuit or the sudden action of the automatic fuse—of a serious rise of potential, which is stored in the windings of the alternator, and can only flow off through the capacity of the transformer or by perforating the insulation. Such voltages rapidly deteriorate the insulation of sunk windings, and so it becomes necessary to find some means of overcoming this difficulty. Two such pieces of apparatus are now available, and may be used in conjunction with each other or separately, according to the conditions controlling the line, area of distribution, capacity of plant, &c., and are known as the "electric valve" and "Moscicki condenser."

The electric valve consists of a number of spark-gaps arranged as follows. The first spark-gap is placed in series with a sufficiently high resistance, so as to avoid high-frequency oscillations, and the remaining spark-gaps are indirectly connected to earth through small condensers, the last spark electrode being connected direct to earth. The spark-gaps are formed between the edges of sharp round discs of non-arcing metal insulated from each other and from the earth connection. The capacity required is obtained by these discs and a central rod which is connected to earth, and also acts as a support for the discs which are insulated from it. The resistance in series with these discs is a metallic one, and obviates the trouble usually due to high resistances of graphite or carborundum.

The first spark-gap is adjustable, and is enclosed in a glass cylinder. Six or more sets of spark-gaps are connected in parallel—each through a high-tension fuse—to a common disc, which acts as one pole, while the cast-iron base to which the columns are bolted acts as the other pole. The columns are protected from dust and damage by a glass cylinder, which rests on rubber pads on the cast-iron base, and is protected on top by an insulated cover.

The characteristics of the electric valve may be summed up as follows:—(1) absolute prevention of high-frequency currents; (2) unlimited capacity for dealing with any energy; (3) the adjustable spark-gaps being enclosed in glass cylinders, there is no likelihood of dust getting between the knobs and causing premature action of the apparatus; (4) the automatic extinction of the arc; (5) erection or dismounting very rapid.

The Moscicki condenser resembles an extremely long Leyden jar, with the difference that the neck of the jar—where the coatings end—is considerably thickened. The coatings are produced by a chemical silvering process, and a heavy deposit on both the inside and outside of the jar is obtained, which is further strengthened and protected by a copper deposit. The jars are then mounted in a tin or brass tube, on the top of which a high-tension insulator is arranged, and carries the contact connected to the inner coating. The outer coating is connected to the metal tube, and the intermediate space is filled with a mixture of glycerin and water. It is then hermetically sealed, and consequently the condenser can be used in any position. Glass is used for the dielectric, owing to its great dielectric capacity and uniformity.

The usual type of condenser as used for line protection consists of a number of tubes, as described above, mounted on a wrought-iron frame, and the inner coatings are connected in parallel through high-tension fuses to a common terminal, to which the line is connected. The outer coatings are connected to the tin or brass tubes, and connected to earth by means of the framework, which is so arranged that each tube can be easily replaced or removed when it is necessary.

The design and action of both the electric valve and the Moscicki condensers are clearly explained in a pamphlet issued by Messrs. Isenthal and Co., of 85 Mortimer Street, W., who have acquired the patent rights for both these forms of apparatus for this country and the colonies.

EDUCATION DURING ADOLESCENCE.[1]

FOR the vast majority of English boys and girls, our system of national education is a torso. It ends too soon. It is a trunk without a head. How to remedy this defect with practical wisdom, without expenditure so immense as to provoke reaction, and with the convinced cooperation of enlightened employers of labour, and of all parents who unselfishly desire to further the best interests of their children, is becoming one of the pressing questions of the day.

Out of some 1,300,000 boys and girls in England and Wales who are between twelve and fourteen years of age there are (to the best of our knowledge) about 211,000 (in addition to partial exemption scholars) who have already obtained exemption from attendance at school, and are receiving no further systematic education. Out of the two million young people in England and Wales who have passed their fourteenth birthday, but are still under seventeen years of age, only one in four (so far as our knowledge goes) receives on week days any continued education. "The result" (I quote the finding of the Consultative Committee) "is a tragic waste of early promise. Through lack of technical training, hundreds of thousands of young people fail to acquire the self-adaptiveness and dexterity in handicraft which would enable them to rise to the higher levels of skilled employment. Through lack of suitable physical training, their bodily powers are insufficiently developed, and their self-control impaired. Through lack of general training, their mental outlook remains narrow, their sympathies uncultivated, their capacity for cooperation in civic welfare stunted and untrained. In the meantime, modern industry, in some of its developments, is exploiting boy and girl labour during the years of adolescence. An increasing number of 'blind-alley' employments tempt boys and girls, at the close of their day-school course, by relatively high rates of wages which furnish opportunities of too early independence, but give no promise of permanent occupation and weaken the ties of parental control."

The present state of things is not only intellectually and economically wasteful, but often morally mischievous. City life enhances the danger. Unskilled, or relatively unskilled, employment at thirteen, with good money, tempts a boy (and an increasing number of girls) like a baited trap. A lad is drawn into a way of life which leaves him at sixteen or seventeen without a trade to his fingers, and with the habit of steady learning clean gone out of his head. The years between thirteen and sixteen or seventeen are the years of educational leakage. We are like people who have laid down a costly system of water supply, but have left a badly leaking pipe just behind the tap. In order that our system of national education for the masses of the people may bear better fruit in personal skill and in civic value, the time has come for us to secure a better foundation in the elementary day schools and the continuance of wise educational attendance during the years of adolescence.

Differ as we may in judgment as to the legislative treatment of the problem, we find, I think, but little disagreement among ourselves in educational aim. Do we not virtually concur in thinking that all boys and girls ought to receive, during the years of adolescence, some form of continued education which will develop their physique, widen their mental outlook, cultivate their sympathies, prepare them for the responsibilities of parenthood, equip them for trustworthy efficiency in the occupation by which they will earn their livelihood, and fit them for the duties of citizenship? If this is to be done, it will be necessary to mortise the work of the day and evening technical classes into the work of the elementary day schools. We need in the latter more training of the hand and of the constructive powers, not with any prematurely technical purpose, but as a necessary factor in brain development and in a liberal education. This will not be possible unless we have smaller classes in the elementary day schools and unless the course of training for teachers can be so prolonged as to permit training in educational handwork to be included in their course of professional preparation without congestion of studies, without overpressure of mind, without encroachment upon the indispensable liberal education, and without undue curtailment of that mental leisure which is needed for all healthy growth of interest, originality, and purpose. Nor do we conceive of the technical class, whether day or evening, as purely utilitarian or technological. Direct bearing upon subsequent employment or occupation it must have. But inseparable from its true educational influence is careful regard for the training of the body, for the cultivation of the sympathies and of the imagination by the love of literature, by music and by art, for an opening of the mind to the significance of civic responsibility, and also for those influences (often most powerful when least expressed in words) which help in forming a purposeful, steadfast, and disinterested character.

It is because the people's high schools in Denmark have not only aspired to these aims, but have largely achieved them, that they have raised the level of culture in the whole nation and have indirectly, and, as it were, in by-product, enhanced the economic welfare of the people. Nor should it be forgotten that the Danish high schools do not receive children during the years immediately following the day-school course, but are confined to pupils above sixteen years of age. For this reason, the Danish high schools are not at present fully grappling with the problem of how best to continue the education of urban children; but the record and success of these schools may well make us hesitate before embracing the conclusion that, for children in the agricultural districts, attendance at a continuation class between fourteen and sixteen is the only, or indeed the best, way of securing the kind of further education most fitted to their needs.

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[1] From a paper on "The Relation of Elementary Schools to Technical Schools—Day and Evening," read at the North of England Education Conference, Leeds, on January 7, by Prof. M. E. Sadler.

Many of the statements now current as to the universality of compulsory attendance at continuation schools in different parts of Germany seem to me unintentionally misleading. After persistent efforts, and with the help of some of the best informed of German educators, I have failed to obtain any comprehensive statistical statement showing the number of boys and girls between fourteen and seventeen years of age in different parts of the German Empire who are actually attending continuation schools. Where I have been able to test such figures as are published, I have been drawn to the conclusion that the enforcement of compulsion, even in those parts of Germany where compulsion is statutory, is less general than the wording of the statutes would lead us to expect. The whole subject calls for closer investigation. There is some reason to think that, even in the progressive parts of Germany (and there are large regions in which education is the reverse of progressive), the problem of securing continued education for the majority of girls, and also for those boys who are not intending to enter a skilled trade, is still far from having been effectively solved. We in England have indeed much to learn from Germany and from some of the cantons of Switzerland, but it is right to remember that, for historical reasons which are far from discreditable to us, we have approached the problem from the point of view of the individual rather than from the point of view of the State. I can find no country in which the voluntary attendance at evening classes is so large in proportion to the adult population as it is in England and Wales. I would venture to urge that our task is so to use the collective power of the State as to stimulate, but not to supersede, the energy and forethought of the individual. Bureaucratic collectivism in education seems to me as false an ideal as, at the opposite extreme, is chaotic and plunging individualism. We need a synthesis between the individual energy of the pupil, the responsibility of the parent, the responsibility of the employer, and the watchful supervision, the financial aid, and the uplifting public purpose of the local authority and of the State. Nor, in this matter of continued education, should we allow ourselves to attach too much importance to academic standards of attainment or of theoretical knowledge. Much of the best education in the world is remote from the class-room.

In England, the difficulties which we find in the way of bringing the elementary schools into closer and more fruitful relation to a stimulating kind of further and largely technical education are partly psychological, partly administrative, partly economic.

A great number of English employers and foremen are lacking in insight into the true meaning and value of education, and also often fail to discharge their moral responsibilities for the further education of the young people in their employment or under their care. Nothing strikes me so much in comparing a German industrial city with an English as the keener interest on the part of the mass of German employers in educational questions, and especially in the educational aspect of the daily duties of the workshop. We in England are apt to forget that education is really an aspect of life, and that every skilled adult may find one of his keenest pleasures in imparting a right attitude of mind and a sense of skill and finish to the young people growing up under his care. These things are partly traditional in a nation, and the unbroken tradition of skilled workmanship which has survived from the Middle Ages to the present day in many of the older German cities is one cause of the German attitude of mind towards industrial and technical training. With us the industrial revolution, which introduced the factory system (great as that achievement was from many points of view), snapped an ancient tradition (which already was half dead) and purposely re-started industry in new places where the old tradition had never grown. The first step towards the diffusion of a deeper insight into the value of education is the extension of a liberal, non-pedantic, non-examination-ridden, secondary education accessible, not only to the employing class, but to those who will rise to be foremen and thus hold responsible, though subordinate, posts in industry and commerce. When a man has himself had at school an education which has affected his whole life, he is more ready to understand the importance of securing a similarly suitable education for other people.

It is idle to deny that a comprehensive system of continued education during adolescence (the kind of system which the country really needs and without which much of its present expenditure runs wastefully into the sand) will be a very costly thing to provide and maintain. On the Consultative Committee we tried to form an honest estimate of the cost. We came to the conclusion that a system of compulsory attendance at continuation schools of all young persons between fourteen and seventeen years of age would, if universally applied in a satisfactory manner, involve for maintenance alone an additional annual expenditure of two and a half million pounds. For my own part, I believe that if the work in continuation schools were made (as it should be made) thoroughly practical, the cost would be considerably greater.

Every month given to the further study of the subject which we are met to discuss impresses upon us more deeply the range and social complexity of the issues which necessarily arise, in this country and elsewhere, whenever the problem of continuation schools is seriously approached. The better adaptation of technical schools, day and evening, to the public elementary-school system involves something far beyond skilful administration on the part of the local authorities, and is on a quite different plane of difficulty from that of previous proposals for the raising of the school age. It would be misleading to discuss the subject with our attention confined to narrow technicalities or administrative details, necessary as those are to the right solution of our difficulties. On the whole, as it seems to me, we have just reason for encouragement as to the future. There are many signs that the nation is approaching the problem in the right attitude of mind and with willingness fairly to consider temperately stated arguments for reform. The growth of this right attitude of mind is much more important than hurried legislation, which, indeed, if precipitately forced on to the Statute Book, would retard rather than hasten our advance. English opinion ripens slowly, but I believe that ultimately it will regard as a social necessity the continued education of young people during adolescence under conditions which will protect them from overwork of body and mind. In the meantime, the Scottish experiment is full of significance for us. The foundations of an effective continuation-school system must be laid through a change in the conditions of attendance and study in the elementary schools. Our primary need is a raising of the normal age for exemption from day-school attendance to the limit adopted in Scotland since 1901. Further, is not the time ripe for imposing on every local authority the statutory duty of making suitable provision of continuation classes for the further education of young persons resident in their district from the time they leave the day school up to their seventeenth birthday, and of keeping a register of all such young persons with a record of their occupations? In order that this duty may be rightly discharged, it appears to me indispensable that the Parliamentary grant in aid of continuation schools should be materially enlarged. Without such aid the poorer districts in town and country will not be able to support the expense of providing instruction sufficiently practical or teachers adequate to the task of imparting it. In this particular grade of education the schools must necessarily compete with industry and with commerce for the services of those who are really competent to teach what the pupils will most require to learn.

With the growth of public confidence in their fair-mindedness and educational insight, the local authorities will acquire that moral authority which will alone enable them to exercise the power, almost certain in the end to be entrusted to them by statute, of prescribing the limit of hours of work which no young person under the age of seventeen may exceed in any day or week in employment and systematic education combined; but in order to secure in an effective way physical, technical, and civic training for all young people during the years immediately following the close of the day-school course, two other statutory changes seem to me to be necessary. First, it should be lawful for the education authority of any county or county borough to make bye-laws (subject to confirmation by the Board of Education) for requiring the attendance at continuation classes up to any age not exceeding seventeen years of any young persons resident or working in their district and not otherwise receiving a suitable education. Secondly, Parliament should make it the statutory duty of every employer of any young person under seventeen years of age (*a*) to enable him or her to attend continuation classes for such period of time and at such hours as may be required by the bye-laws of the local education authority of the district in which such young person either works or resides, and (*b*) to supply the names of all such young persons to the local authority on its demand; and, in order to secure the regular attendance of pupils at technical and other continuation classes in areas where such attendance is made compulsory by bye-law, all employers in such trades or parts of the district as the bye-law may specify should be forbidden, under penalty, to employ any young person under seventeen years of age who fails periodically to produce a card attesting his or her attendance at continuation classes in conformity with the terms of the local bye-law.

These are the central and fundamental recommendations unanimously made by the Consultative Committee of the Board of Education. They are so designed as to stimulate individual energy within the necessary framework of administrative unity.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A POST-GRADUATE course of seven lectures on "Photo-electricity" will be given at King's College (University of London) during the Lent term, by Dr. H. Stanley Allen, on Wednesdays, at 5 p.m., beginning on January 19. These lectures are open without fee to internal students of the University on production of a card of admission from their college.

IT is stated in *Science* that Mr. Henry Phipps, of New York, founder of the Phipps Institute in Philadelphia, has presented to the University of Pennsylvania the sum of 100,000*l*., to be used in the campaign against tuberculosis. Six years ago Mr. Phipps founded the Phipps Institute for Tuberculosis Research in Philadelphia, with a large endowment. In 1908 he gave 100,000*l*. to the Johns Hopkins University for the founding of a psychiatric clinic. From the same source we learn that the eleventh industrial fellowship at the University of Kansas has been established by the Pacific Coast Borax Company, of Oakland, California, and will be known as the Borax fellowship. The amount which this company will pay to support the work of its fellow is 150*l*.

WE learn from the *Pioneer Mail* that the Government of Bombay, in a letter to the University Senate, says the offers of contributions which have been made by the leading citizens render it possible to begin the establishment of a central institute in Bombay for the teaching of science. Such an institute is needed urgently in order that the Presidency may have advantages essential to progress which are now reaped by other countries. Before practical steps can be taken in this direction it is necessary to consider what classes of students should be provided for and how the teaching of science can be blended with the system of higher education under the direction of the University. The Governor in Council, after considering the existing curriculum, concludes that radical changes are necessary if the teaching of science and higher education generally are to be brought into harmony with modern requirements.

THE current issue (No. 29) of the *Transvaal Agricultural Journal* contains an article on the desirability of founding a national college of agriculture for the Transvaal. A million pounds is asked for as an endowment, and it is suggested that the college should be thrown open to all students from the British Empire. Mr. F. B. Smith, the Director of Agriculture, has repeatedly urged the necessity for a well-organised scheme of agricultural education in South Africa, and has, indeed, already opened a college at Potchefstroom, under Mr. Holm's principalship. A number of letters from distinguished Americans are printed setting forth the great advantages that have accrued in the United States from the elaborate system of agricultural colleges and experiment stations established there. As the Transvaal already possesses one of the best agricultural departments in the British Empire, it seems fitting that it should also possess the greatest agricultural college.

MUCH educational information of interest and importance is to be found in the latest report of the U.S. Commissioner of Education. We notice that attention is directed to the 1908 report of the Prussian Minister of Public Instruction, which gives a list of twenty-six States comprising the German Empire and their relative university attendances. The list makes it clear that south Germany supplies a relatively greater number of students than Prussia and Saxony. This is noteworthy, because the south has many more small shop industries and smaller farms than the north. The proportion of Prussia would be smaller still if Berlin were excluded. Of the thirteen Prussian provinces, nine remain below the Prussian average. Those districts of the north which are chiefly agricultural furnish few university students, while the agricultural districts of the south furnish many more than the Prussian average, and more than the average of the Empire. Among every 10,000 male inhabitants in east and north Germany in 1905–6, 10·90 were attending universities, in middle and west Germany 12·63, and in south Germany 14·25. Whether analogous results would be noticed if the attendance at technological institutes, agricultural colleges, mining schools, and so on were considered cannot be stated with certainty. In a few years the relative attendance will be greatly changed, since Prussia has opened its universities to women.

THE inaugural address of Prof. H. J. Waters on the occasion of his formal installation as president of the Kansas State Agricultural College, Manhattan, is given in a recent number of *Science* (December 3, 1909). Prof. Waters dealt with the development of the agricultural college in America, and pointed out that, as only one out of every four hundred school children ultimately graduates at college, steps must be taken to bring the work of the colleges to the people. The farmers' institutes do splendid work in this direction, bringing no fewer than one-third of the farmers into personal touch with the college representatives, while as soon as funds are forthcoming the experimental work is to be carried into every county in the State. In justification of these proposals he says, in reference to the past methods of management:—"Ours has been a waste of the resources of soil and forest and stream that is without parallel in the history of the world. This waste has been largely due to improper systems of farming, and cannot continue another century without bringing ruin to American basic industry." The new department of public highways at the college will urge the importance of good country roads, and supervise their construction as soon as the money is forthcoming. In plant and animal improvement, also, the college must lead the way, since it alone can carry on a well-planned programme for an indefinite time. The distinct position occupied by the experiment station was well brought out. Its function was to create agricultural knowledge, not simply to benefit the farmer directly, but to make an exact science of agriculture and enable it to be taught successfully in the colleges, schools, farmers' institutes, and on demonstration farms. Lastly, the rural school problem was dealt with, and this seems to be as far from a satisfactory solution in America as it is here. Not only is there a lack of suitably trained teachers, but, so far, no satisfactory scheme of working the school has been devised. The address is highly suggestive.

THE Education Department of the London County Council has circulated particulars of the science and technology scholarships and exhibitions which are open for competition. The Council is prepared to award in 1910 not more than fifteen scholarships in science and technology, consisting of free education at recognised polytechnics, technical institutes, or institutions of university rank, together with, in cases where the Council thinks fit, maintenance grant, to be fixed after consideration of the circumstances of each candidate, but not to exceed 50*l.* a year in any case, and to be tenable for a period of two years, with a possible extension for a third year. The scholarships will be open to persons engaged in industrial pursuits who have attended evening classes at polytechnics, technical institutes, or colleges of university rank. Also not more than 180 evening exhibitions in science and technology, to be open to persons engaged in or intending to engage in industry, each exhibition to consist of payment of tuition fees, together with a grant of 3*l.* a year, and to be tenable for two years, with a possible extension for a third year. Full particulars of the conditions under which the awards will be made are contained in a pamphlet to be obtained from the L.C.C. education officer. There will be two distinct compeitions, viz. Classes A and B. Candidates for the scholarships must compete under Class B; those for the exhibitions may compete under either Class A or Class B. The teachers' reports will also be taken into account. The award of exhibitions by the competition in Class A will be confined to candidates who, in the case of boys, are less than eighteen, and, in the case of girls, are less than nineteen, years of age on July 31, 1910, and have attended classes in the subjects which they offer for examination for not less than 150 registered hours during the two previous school years at one of the Council's evening schools or evening centres. These candidates will be required to take an examination to be conducted by the Council in certain subjects of general education. Candidates in Class B may compete in either of two ways, by entering for an examination in two subjects, or by submitting works and also undergoing a test examination in one subject. The principals and headmasters or headmistresses of the institutions or schools at which the candidates are in attendance will be asked to submit full reports on their work. In making the award, account will be taken of these reports as well as of the candidates' work in the examination. Fuller particulars of the Council's scholarships, &c., appear in the Council's Scholarships Handbook, published by Messrs. P. S. King and Son, 2 and 4 Great Smith Street, Westminster, S.W., price 1*d.*

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, December 15, 1909.—Prof. W. J. Sollas, F.R.S., president, in the chair.—R. H. **Rastall**: The Skiddaw granite and its metamorphism. The visible exposures of the Skiddaw granite are three in number, all very similar; part of the more northerly one is a greisen, which is not here dealt with. The normal granite is more or less porphyritic in structure, with large phenocrysts of perthite, in a coarse- or fine-textured ground-mass of orthoclase, plagioclase, biotite, and muscovite. Evidence is brought forward to indicate that the granite is intruded along the axis of an anticline, with a strike approximately E. 15° N. and W. 15° S., the normal direction for the district. The metamorphic aureole is very large, measuring about six miles from east to west, and five miles from north to south. This is out of all proportion to the size of the visible exposures of granite, and it is inferred that the intrusion underlies a large area at a small depth. Within this area three distinct rock-types can be recognised, namely:—(1) black slates; (2) grey flags; (3) grey grits. The metamorphism produced in each of these is described in detail, and it is shown that the commonly accepted zones of alteration do not hold, since the rocks concerned were originally of very different character. The phenomena displayed may be summed up as an example of a moderate degree of thermal metamorphism, due to the intrusion of a large mass of granite, at a comparatively low temperature, into a series of rocks of variable composition, which had previously undergone dynamic metamorphism.—A. M. **Finlayson**: The metallogeny of the British Isles. The ore-deposits of the British Isles (tin, copper, lead, zinc, gold) are considered synthetically in their relation to igneous rocks and to tectonics. The great bulk of the deposits of economic importance, including the veins of Cornwall and Devon, the lead, zinc, and copper veins in England, southern Scotland, Wales, and Ireland, are of Hercynian (and Armorican) age. This is shown by the age of the fissuring in many cases (post-Carboniferous to pre-Triassic), by the absence of ore-veins in Jurassic or later formations, and by other evidence. The Tertiary volcanic period was not accompanied by ore-deposition. The ore-deposits are classified according to metallogenetic epochs, and are divided into metallogenetic provinces, as has been done by Prof. L. de Launay with the ore-deposits of Italy, Africa, and Siberia. The essential features of the different groups are summed up. The evidence, collected and sifted, indicates the following zones of ore-deposition:—(1) Pneumatolytic zone: tin, passing up into copper. (2) Deeper vein-zone: copper with gold. Lead and zinc subordinate. (3) Middle and upper vein-zones: lead and zinc. Copper subordinate. The conclusions drawn from the investigation are:—(i) The importance of the physical conditions of the Permo-Trias in favouring ore-deposition in upper zones. (ii) The close connection between metallogenetic and petrographical provinces, and the essential dependence of ore-formation throughout geological time on the differentiation of igneous rocks accompanying great crustal movements. Differences in ore-deposits in different localities and regions appear to be due to primary differentiation of ores accompanying the differentiation of igneous magmas at successive epochs.—F. P. **Mennell**: The geological structure of southern Rhodesia. The author describes in some detail a portion of what may be termed "the Laurentian area" of Africa. The oldest rocks include all lithological varieties, and exhibit most of the known types of alteration. They comprise a great development of hornblendic rocks (epidiorites and amphibolites); on the other hand, mica-schists, and sheared rocks generally, are conspicuously absent. They include (1) "basement schists" on which the altered sediments were laid down, and (2) altered basic igneous intrusions, simulating rocks of any previous age. All these are older than the granites by which they, and the metamorphic series, are invaded. The vertically bedded "ironstone series" is described, and is compared with similar rocks of the Lake Superior region. They are shown to be especially developed along the eastern border of Matabeleland. The conglomerate beds (or Rhodesian "banket") are 10,000 feet thick, and rest unconformably upon the ironstone series in the west, both these formations being gold-bearing. The thick crystalline limestones overlying the conglomerate series contain chert and dolomite, the latter rock occurring also as an alteration product from serpentine. Graphite also is found, and is attributed to the insolubility of carbonaceous matter in a highly siliceous magma. The granites occupy the greater part of the area dealt with, and their intrusive character as regards the metamorphic rocks is shown. No fossils are recorded, other than silicified wood, except in the coal-bearing beds, in which occurs *Palaeomutela keyserlingi* of the Russian Permian, as also plants. The paper concludes with a description of the diamond-bearing beds of Rhodesia, which resemble those of Kimberley, and also contain fragments of eclogite.

Royal Microscopical Society, December 15, 1909.—Mr. E. J. Spitta, vice-president, in the chair.—A. A. C. E. **Merlin**: The measurement of Grayson's 10 band plate.—Dr. M. **Ewell**: A convenient form of stand for use as a micro-colorimeter and with micro-spectroscope.—Dr. J. F. **Gemmell**: An automatic aërating apparatus for aquaria.—F. **Enock**: The life-history of the Hessian fly, with notes on the Tenby wheat midge. Although known in America so far back as 1776, and believed to have been introduced there in the straw mattresses of some Hessian troops, it was not until 1886 that public attention was directed to the Hessian fly in this country. The fallacies then circulated were described and corrected, and the true life-history, as traced by the author, was given. Some notes on observations on the Tenby wheat midge, *Clinodiplosis equestris*, followed.

PARIS.

Academy of Sciences, January 5.—M. Emile Picard in the chair.—Address by the president.—A. **Lacroix**: The existence on the Ivory Coast of a petrographic series comparable with that of charnockite. All these rocks constitute a continuous and comprehensive series passing from granite to a hypersthene almost solely formed of quartz and felspars. The series is interesting as being very rare, and forms a parallel with that of the alkaline and alkalino-calcic rocks.—G. **Koenigs**: Conjugate curves in the most general relative displacement of two bodies.—A. **Demoulin**: The transformation of Ribaucour.—G. **Tsitzéica**: A problem on triple orthogonal systems.—Arnaud **Denjoy**: Uniform analytical functions with discontinuous non-isolated singularities.—Camille **Hautier**: The adiabatic compression of air applied to a vehicle moved by an explosion motor in order to replace mechanical transmission.—A. **de Gramont**: The re-partition of the ultimate rays in the spectrum of different regions in the sun.—E. **Voisenet**: The production of small quantities of formaldehyde in the oxidation of ethyl alcohol by chemical, physical, or biological means. Formaldehyde is constantly formed in the oxidation of ethyl alcohol, free from all trace of methyl alcohol.—E. **de Stoecklin**: A new method allowing of the liberation of traces of alcohols.—L. **Margaillan**: The separation of saccharose and lactose by the "bulgare" ferment.—Pierre **Berthault**: The wild types among cultivated potatoes.—Th. **Mamelle**: The use of potassium cyanide as a subterranean insecticide. This salt injected in aqueous solution in the soil is decomposed by the acidity of the latter, the hydrocyanic acid gas thus permeating the whole.—Mdlle. P. **Cernovodeanu** and Victor **Henri**: A study of the action of ultra-violet rays upon microbes.—C. **Levaditi** and R. **Landsteiner**: Experimental infantile paralysis.—Jean **Boussac**: The nummulites of the zone of the flysch at the west and south-west of the Mercantour.—Héribaud **Joseph**: Investigations on the diatoms of the travertines deposited by the mineral waters of Sainte Marguerite (Puy de Dôme).—E. **Péroux**: The boring of the artesian well of the Maisons-Laffitte.

NEW SOUTH WALES.

Linnean Society, November 24, 1909.—Mr. C. Hedley, president, in the chair.—Dr. H. I. **Jensen**: The variable character of the vegetation on basalt soils. The different types of basaltic country in eastern Australia, and the factors which control the vegetation thereof, may be briefly summarised as:—(1) The tropical or subtropical, coastal basalt scrubs (jungle), with a high rainfall; the soil is very rich, and has a high water-retaining power but low porosity. (2) The extra-tropical, coastal basaltic ranges of southern New South Wales, with a colder climate and a lower rainfall; rapid corrosion and erosion, unhindered by dense vegetation, have given rise to steep slopes, and these have an excellent natural drainage and a stony soil. (3) The almost treeless basaltic plains west of the Great Dividing Range, the dearth of vegetation being due to a low and uncertain rainfall, and sometimes to a cold climate as well. (4) The isolated basaltic knolls of the western interior, usually stony and bare of soil, their barrenness being due to two causes; the basalt is such a compact, homogeneous, and even-grained rock, and the climate so arid, that decomposition is extremely slow, and as the minerals all decompose with about equal readiness, the soil formed is very finely divided, and is removed by the wind practically as fast as it is formed. (5) The basaltic bogs of plains and tablelands, with a water-logged soil due to inefficient drainage, and a soil-water charged with deleterious salts. Hence it will be seen that the defect of basaltic soils is never want of plant-food. The most serious drawbacks are high water-capacity, which causes the asphyxiation of plants in wet weather, and low capillarity power, which impedes a renewal of soil-moisture in droughty seasons.—Dr. W. G. **Woolnough**: The geology of the Tallong-Marulan area, N.S.W. This area has already formed the subject of a communication to the society by Mr. T. G. Taylor and the author. In that paper the physiography was dealt with, and a fine case of river-capture on a large scale described. The district is very remarkable for the great variety of its geological formations. Ordovician, Silurian, Permo-Carboniferous, and Tertiary fossiliferous strata are developed, while eruptive rocks are represented by a great boss of grano-diorite, grading into granite-porphyry and dacite, intersected by complementary dykes of aplitic and lamprophyric character, and by extensive basalts and basalt tuffs. The Ordovician rocks are the nearest to Sydney at present known, and contain abundant beautifully preserved graptolites, series of which have been exhibited at the meetings of the society. The Silurian rocks include two thick belts of fossiliferous limestone in which extensive caves occur. The Permo-Carboniferous rocks are somewhat abnormal in character, lying as they do at the extreme south-western corner of the basin. The formation consists chiefly of coarse conglomerates and breccias. A seam of inferior coal is developed. The grano-diorite mass presents some very interesting problems in magmatic intrusion. It is suggested that it is a laccolitic mass only just laid bare by denudation. The very important problems of magmatic differentiation presented by this mass are not dealt with in this paper. Extensive contact-metamorphism is met with in the district, and a preliminary description of this is given.—E. J. **Goddard**: Contribution to our knowledge of Australian Hirudinea, part iv., with a note on a parasitic endoproctous polyzoon. The paper comprises a detailed account of a leech found in the Brisbane River, which is regarded as indistinguishable from the Jamaican *Pontobdella macrothela*, Schmarda, and descriptions of a species of Pontobdella from the Hawkesbury Estuary, and one of Geobdella from British New Guinea. Certain incomplete but abundant structures adherent to examples of the second of these are pronounced to be the stalks of an endoproctous polyzoon, possibly allied to Loxosoma. Similar structures were erroneously supposed to be the spermatophores of a leech by Macdonald.—L. A. **Cotton**: The tin deposits of New England, N.S.W., part i., the Elsmore-Tingha district. There are three geological units within the tinfield:—(1) a series of slates and claystones; (2) a series of granites; (3) a series of basalts; while a fourth flanks its eastern side. The slates are Palæozoic, and are probably of Silurian age. The basalts are the youngest of the formations, and their age has been determined as Tertiary. The granites are intrusive into the Palæozoic slates, and their age has been provisionally stated as Permian. There are two chief granite types:—(1) the "acid granite" of Mr. E. C. Andrews, which is chiefly a quartz-felspar rock; (2) an older and more basic rock, the Tingha granite. The tin-ore deposits have been found always closely associated with the "acid granite," though post-dating the solidification of that rock. On examining the fracture-systems of Elsmore, Emmaville, and Tingha, it was concluded that the force causing these was a thrust from the east, or a torsional stress having the axis of torsion approximately east and west. It was noted that the system of fractures corresponds closely with the general trend of the tin-bearing belt, both being best developed in a direction about N.E. by E. The tin-ore deposits are discussed under several heads, the chief among them being (*a*) the quartz-quartzose type; (*b*) the quartz-felspar type; (*c*) the pipes; (*d*) the chlorite deposits.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 13.

ROYAL SOCIETY, at 4.30.—On the Atomic Weight of Strontium: Sir Edward Thorpe, C.B., F.R.S., and A. G. Francis.—On the Approximate Arithmetical Solution by Finite Differences of Physical Problems involving Differential Equations, with an Application to the Stresses in a Masonry Dam: L. F. Richardson.—On a Method of Determining the Viscosity of Gases, especially those Available only in Small Quantities: A. O. Rankine.—Recombination of Ions at Different Temperatures: Dr. P. Phillips.—On the Electricity of Rain and Snow: Dr. G. C. Simpson.—On the Polarisation of X-Rays compared with their Power of Exciting High Velocity Kathode Rays: L. Vegard.

MATHEMATICAL SOCIETY, at 5.30.—The Transformations of Coordinates which can be used to transform One Physical Problem into Another:

H. Bateman.—On Homogeneous Oscillation: Dr. W. H. Young.—On the Determination of a Semi-continuous Function from a Countable Set of Values: Dr. W. H. and Mrs. Young.—Note on a Former Paper on th[illegible]ry of Divergent Series: G. H. Hardy.—On the Expression of [illegible]n Function by Means of a Series of Polynomials: Dr. H. F. [illegible]r.—On the Theory of the Cubic Surface: Dr. H. F. Baker.—The [illegible] Functions associated with the Parabolic Cylinder: G. N. [illegible]tson.—Note on the Theory of Sets in Probabilities: Dr. H. de S. Pittard.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Lord Kelvin's Work in Telegraphy and Navigation (*Second Kelvin Lecture*): Prof. J. A. Ewing, C.B., F.R.S.

FRIDAY, JANUARY 14.

MALACOLOGICAL SOCIETY, at 8.—Note on *Helix desertorum*: Mrs. G. B. Longstaff.—Description of *Thersites* (*Glyptorhagada*) *Hillieri*, n.sp., from Central South Australia: E. A. Smith.—Note on *Athoracophorus Schauinslandi*: Henry Suter.—The Ampullaridæ of the Eastern Hemisphere. Description of New Species of Donovania, Scutellina, Fissurella, and Pisania: G. B. Sowerby.—Marine Mollusca from the Kermadec Islands. Notes on Polyplacophora, chiefly Australasian: T. E. Iredale.—Helicoids from New Guinea and Description of a New Species of Papuina: G. K. Gude.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Moon in Ultra-violet Light: Spectro-selenography: R. W. Wood.—Radial Movement in Sun-spots: *Second paper*: J. Evershed.—On Mr. Fotheringham's Criticisms, *Monthly Notices*, Vol. lxix., pp. 669–73: E. Nevill.—A Last Word on the Correlation of Variable Stars: Karl Pearson.—The Principal Formulæ of Interpolation and Mechanical Differentiation and Integration: H. C. Plummer.—Note on some Sun-spots visible in September, 1909: Col. E. E. Markwick.—*Probable Papers*: Observations of Occultations of Stars by the Moon made at the Royal Observatory, Greenwich, in the year 1909: Astronomer Royal.—Observations of Minor Planets from Photographs taken with the 30-inch Reflector of the Thompson Equatorial at the Royal Observatory, Greenwich, during the year 1909: Astronomer Royal.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Some Uses of Mechanical Power in Engineering Construction: H. F. Donaldson, C.B.

MONDAY, JANUARY 17.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Direct Separation of Emulsions by Filtration and Ultra-Filtration: E. Hatschek.—Significance of the Abel Heat Test of Gun Cotton and Nitro-glycerine: R. Robertson and B. J. Smart.—Note on the Estimation of Iron in Ferric Solution: A. F. Joseph.

ROYAL SOCIETY OF ARTS, at 8.—Textile Ornamentation: Alan S. Cole, C.B.

TUESDAY, JANUARY 18.

ROYAL INSTITUTION, at 3.—The Cultivation of the Sea: Prof. W. A. Herdman, F.R.S.

INSTITUTE OF METALS, at 10.30 a.m.—Address by the President, Sir Gerald Muntz, Bart.

ZOOLOGICAL SOCIETY, at 8.30.—Report on Pathological Observations at the Society's Gardens during 1909: Dr. H. G. Plimmer.—Zoological Collections from Northern Rhodesia and Adjacent Territories: *Lepidoptera Rhopalocera*: S. A. Neave.—On the Marine Fishes and Invertebrates of St. Helena: J. T. Cunningham.—Notes on the Hydroids and Nudibranchs of Bermuda: W. M. Smallwood.—On New or Rare Crustacea of the Order Cumacea from the Collection of the Copenhagen Museum. Part II., The Families Nannastacidæ and Diastylidæ: Dr. W. T. Calman.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: The Design of Rolling Stock for Smooth-rail Working on Heavy Gradients: F. W. Bach.—*Probable Paper*: The Reconstruction of the Tyne North Pier: I. C. Barling.

FARADAY SOCIETY, at 8.—The Conditions which Determine the Composition of Electro-deposited Alloys. Part II., Silver-copper: S. Field.—Studies in the Electro-deposition of Metals: Dr. F. Mollwo Perkin and W. E. Hughes.—The Compressibilities of Helium and Neon: F. P. Burt.—Gas-washing Bottles with very Slight Resistance to the Passage of a Gas: Dr. A. C. Cumming.

WEDNESDAY, JANUARY 19.

INSTITUTE OF METALS, at 10.30 a.m.—*Probable Papers*: The Use of Carbonaceous Filters in the Smelting of Zinc, as employed in the Hopkins Fumeless Zinc Process: C. O. Bannister.—The Properties and Constitution of Copper Arsenic Alloys: G. D. Bengough.—The Failure in Practice of Non-ferrous Metals and Alloys, with Particular Reference to Brass Loco-tubes: T. Vaughan Hughes.—A Contribution to the Study of Phosphor Bronze: O. F. Hudson and E. F. Law.—Notes on a Suggested Record of Analyses: C. A. Klein.—The Analysis of Aluminium and its Alloys: Dr. R. Seligman and F. J. Willott.—The Assay of Industrial Gold Alloys: E. A. Smith.

ROYAL SOCIETY OF ARTS, at 8.—The Japan-British Exhibition, 1910: Count Hirokichi Mutsu.

ROYAL MICROSCOPICAL SOCIETY, at 8.—President's Address: Sir E. Ray Lankester, K.C.B., F.R.S.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.

ROYAL METEOROLOGICAL SOCIETY, at 7.30, Ordinary Meeting.—At 7.45, Annual General Meeting.—Presentation of the Symons' Gold Medal to Dr. W. N. Shaw, F.R.S.—Presidential Address: Some Relations of Meteorology with Agriculture: H. Mellish.

THURSDAY, JANUARY 20.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Further Observations on the Pathology of Gastric Ulcer (Progress Report): Dr. C. Bolton.—(1) The Velocity of Reaction in the "Absorption" of Specific Agglutinins by Bacteria, and in the "Adsorption" of Agglutinins, Trypsins, and Sulphuric Acid by Animal Charcoal; (2) On the Absorption of Agglutinin by Bacteria, and the Application of Physico-chemical Laws thereto: Georges Dreyer and J. Sholto Douglas.—Observations on the Rate of Action of Drugs (Alcohol, Chloroform, Quinine, Aconitine) upon Muscle as a Function of Temperature: Dr. V. H. Veley, F.R.S., and Dr. A. D. Waller, F.R.S.—An Examination of the Physical and Physiological Properties of Tetrachlorethane and Trichlorethylene: Dr. V. H. Veley, F.R.S.—The Action of Antimony Compounds in Trypanosomiasis in Rats: J. D. Thomson and Prof. A. R. Cushny, F.R.S.—"Amakebe,' a Disease of Calves in Uganda: Colonel Sir David Bruce, C.B., F.R.S., Captains A. E. Hamerton, H. R. Bateman, and F. P. Mackie.

ROYAL INSTITUTION, at 3.—Assyriology: Rev. C. H. W. Johns.

LINNEAN SOCIETY, at 8.—Discussion on the Origin of Vertebrates: Dr. Gaskell, Dr. Gadow, Mr. Goodrich, Prof. Starling, Prof. MacBride, Dr. Smith Woodward, Prof. Dendy.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, JANUARY 21.

ROYAL INSTITUTION, at 9.—Light Reactions at Low Temperatures: Sir James Dewar, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Ninth Report to the Alloys Research Committee: On the Properties of some Alloys of Copper, Aluminium, and Manganese (with an Appendix on the Corrosion of Alloys of Copper and Aluminium when exposed to the Sea): Dr. W. Rosenhain and F. C. A. H. Lantsberry.

PHYSICAL SOCIETY, at 5.—Saturation Specific Heats, &c., with van der Waals' and Clausius' Characteristics: R. E. Baynes.—The Polarisation of Dielectrics in a Steady Field of Force: Prof. W. M. Thornton.—On the Use of Mutual Inductometers: Albert Campbell.

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THURSDAY, JANUARY 20, 1910.

LORD KELVIN'S EARLY LIFE.

Lord Kelvin's Early Home. Being the Recollections of his Sister, the late Mrs. Elizabeth King; together with some Family Letters and a Supplementary Chapter by the Editor, Elizabeth Thomson King. Pp. xii+245. (London: Macmillan and Co., Ltd., 1909.) Price 8*s.* 6*d.* net.

THIS fascinating volume gives us a vivid picture of the home life of the remarkable family into which Lord Kelvin was born eighty-five years ago. It is mainly the work of his eldest sister, Mrs. Elizabeth King, who kept many notes and casual diary records, and it has been lovingly edited by her daughter, who has added a brief supplementary chapter. Of that family Lord Kelvin was the last survivor.

Its head was James Thomson, born in 1786, the son of a farmer in county Down, who died in 1849 when professor of mathematics in Glasgow University. His "forbears" had come more than a century before from Ayrshire in the "killing time" of Claverhouse, and the farm on which they settled remained in their possession until 1847, when James Thomson's eldest brother was obliged to leave it for Belfast in the distressful days of the Irish famine.

James Thomson was the Benjamin of the country farmhouse. There were four older children, the youngest ten years older than him. His sister taught him to read, "using handkerchiefs with mottoes and verses printed on them composed by the patriots who brought about the rebellion of 1798." He taught himself arithmetic from a dilapidated copy of Bonycastle, with which he fortunately fell in, "not only mastering its contents, but supplying many pages that were wanting." While still very young he was sent to a day school, and he had no other teaching until he went to Glasgow College. Everything about the boy helped him to educate himself. There was an old sundial in front of the house which fascinated him, and which he tried to reproduce. But his new dials failed to tell the time of day. One very hot summer night, as he lay awake thinking on the problem in his bed out in a garden-house, the theory of dialling dawned on his mind, and he soon worked it out until he was able to make sundials to be placed horizontally, perpendicularly, or at any angle whatever. Some of the dials he made then still exist.

He came across the narrow seas to Glasgow College, as many Irish boys used to do before the Queen's Colleges were set up about 1846. He spent many winters there, taking his M.A., going through most of the medical classes, and the complete theological course with a view to entering the ministry. But when he left the university he was appointed teacher of arithmetic and geography in the newly established Royal Belfast Academical Institution. In a short time it became a college, having preparatory schools connected with it, and it was the forerunner of Queen's College, Belfast. James Thomson was appointed professor of mathematics in the college, in addition to his work in the school. He had found his vocation.

Some time after, when he was thirty-one years of age, he married Margaret Gardiner, daughter of a prosperous Glasgow merchant. She had come across the year before to visit a cousin, Dr. Cairns, a colleague of Dr. Thomson's in the institution. She became engaged to Dr. Thomson, and was married the year following. Their wedding journey was through the Highlands. The Scotch bride settled in Belfast, and died there after twelve happy years of married life. James Thomson brought the motherless family of six children to Glasgow University when he was appointed professor of mathematics in 1832. The eldest daughter, Elizabeth, whose notes and recollections are the basis of the book, was fourteen when they came to Glasgow; the youngest, Robert, was three. They had been seven in number when their mother died. After her death, and before they went to Glasgow, the youngest girl, named after her mother, faded and died. Mrs. Thomson's younger sister, Agnes, who had herself married in 1826, was left in charge of the family, and brought them over to their new home. The family were Elizabeth, aged fourteen; Anna, aged about twelve; James, aged ten; William, aged eight; John, aged six; and Robert, aged four. This younger sister, Agnes—Mrs. Gall—had been brought up in Glasgow by the elder sister, Mrs. Thomson, and felt for her the warm affection of a daughter.

The sixteen years in Belfast, with the young family growing about his knees, were perhaps the most epoch-making of his life. No family ever owed more to their father and mother. For many years, says the eldest daughter, they had no other teacher, except for French and writing, music and dancing. Dr. Thomson

> 'was in the habit of rising at four to work at his books. Some coffee and cream and a spirit lamp having been put ready for him, he made himself a cup of hot coffee before beginning. In these quiet morning hours he got through an immense amount of work before his professional duties began. His books on arithmetic, mathematics, geography, &c., went through very many editions which constantly needed revising and bringing up to date, so that he was occupied with them more or less to the end of his life. As professor of mathematics, during the winter months he lectured every morning from eight till nine, and from eleven to twelve in the forenoon. In the afternoon he was occupied with his school classes, and these ended he regularly went to the news room and the commercial buildings for a little while. Our mother was always waiting for his return, with the children about her. Very eagerly we listened for his knock, and ran to the door, and helped him to take off his things, and then heard some stories from him of what was going on in the world. After dinner we children came down again, and a bit of bright burning cannel coal was put on the fire, which blazed up and filled the room with dancing light; the globes were placed on the table, and we gathered round; little Willie and sometimes James also on the table beside the globes while our father explained their use and taught us to work out problems in them. William was scarcely four when he began to take some part in these cheerful after-dinner lessons, and from the very first he showed the wonderful mental capacity with

which he was endowed. What lovely memories rise up as I recall that dear fireside of long ago—our father and mother sitting there among us."

All his life Lord Kelvin used to testify that his father had taught him everything he had learned until he went to college in Glasgow. Here is another picture of the family:

"It was the next winter that James (then eight) and William (then six) were first sent to some classes in the Institution for an hour or two in the day, and the delightful after-dinner lessons and readings with our dear father were continued with ever increasing profit and pleasure. As we dined at half-past four and the meal was quickly despatched, we had long evenings with him. He gathered us about him, and in every way strove to supply the place of our lovely mother. He was indeed both father and mother to us, and watched over us continually. William was a great pet with him, partly perhaps on account of his extreme beauty, partly on account of his wonderful quickness of apprehension, but most of all, I think, on account of his coaxing, fascinating ways, and the caresses he lavished on his 'darling papa.' When his father stooped to greet him the child would fling his arms about his neck, and smother him with kisses and stroke his cheeks endearingly. . . . I do not remember that any of us were ever in the slightest degree jealous of William on account of our father making him a little more a pet than the rest of us. We were proud of him, and indeed we thought the child petted the father even more than the father petted the child; but we saw plainly that the fondling of his little son pleased him. Willie always slept in a small bed in our father's room—that is, after his early nursery days—because he had for some years a tendency to sleep-walking, which for a time caused some anxiety."

Prof. Thomson's first session at Glasgow brought something of a disappointment. In those days there was no arrangement for a pension—when, through age or infirmity, a professor retired. The outgoing professor often made a private arrangement with the new-comer. Lord Kelvin's sister tells us that under such an arrangement his father actually had at first to pay his predecessor more than the chair brought in.

"To mitigate the loss, he announced an afternoon course of lectures for ladies on geography and astronomy, to be given twice a week in his classroom. Such a thing had never been heard of before in the university, and it was extremely popular. The large class-room was crowded in every corner, and it was a novel and interesting spectacle to see bench rising above bench filled with fashionably dressed ladies, every one looking intent, and many taking notes. All the belles of Glasgow were among the students. This class was carried on for two or three years with undiminished popularity—till the pressure of other engagements compelled my father to give it up, the regular mathematical class becoming so large as to give him quite as much work as he could overtake."

New arrangements also were made with his predecessor, and the ladies' classes had to be given up. The children's education continued to occupy the father's time.

"We did not go to school, but our father, as hitherto, took the general supervision of our lessons. William and James began Latin with him on the Hamiltonian system, and made rapid progress. They also attended the junior mathematical class as listeners, without being examined or writing the exercises. In a letter to William, dated May 7, 1886, Mr. Wallace, an old student of our father's, writes:—'It was in a very large class that as a mere child (ten years old then) you startled the whole class, not one of whom could answer a certain question, by calling out, "Do, papa, let me answer." The impression on my mind has never been effaced.'"

Mrs. King writes again:—

"Our first summer in Scotland was spent at Rothesay, and there our father devoted himself indefatigably to our education. Every morning the four elder children—ages fifteen, thirteen, eleven, nine—spent some hours with him in his study, and always after lessons he took us out for a walk, and made the walk a daily pleasure with his varied converse."

Next session—1834—the aunt, Mrs. Gall, had to leave them to join her husband, and Elizabeth, now a girl of sixteen, became mistress of the house. It is most interesting to follow the course of their studies. The two girls read Latin (Cæsar's Commentaries)

"with our father during his breakfast—our own porridge and milk having been despatched earlier. The two boys, James and William, went in the morning to college classes—the girls taught their two younger brothers piano, and writing, arithmetic, geography, also a little French and Latin, and read Goldsmith's History of England. Nor was poetry neglected in this course of study. I got books from the college library to read about painting and about the lives and works of the old masters. After dinner our father gave us a short mathematical lesson, and after that he read aloud to us. During this winter he thus read the whole of Pope's Iliad and Odyssey, several of the plays of Shakespeare, those also of Goldsmith and Sheridan, besides selections from the old poets. William had the strongest sense of humour of any of us, and not only enjoyed it himself, but set all the little party laughing mirthfully whenever a humorous passage occurred. Mrs. Malaprop and Bob Acres, &c., were most inspiring. Whilst our father read, Anna and I sewed—not fancy work, but flannel petticoats and the like—and our brothers lay on their backs on the floor with their arms extended, to give them a rest and help them to grow straight. The reading was followed by a lively tea, after which our father returned to his study, the two youngest children were taken up to bed, and the four elder adjourned to the drawing-room. James and William were attending Dr. Cooper's natural history class, and in the evenings they retailed their lectures to their sisters after tea. William was not ten till the following June. I was James's pupil, and Anna was William's. About 9 o'clock James and William went to bed, and Anna and I went down to the study to our father, who took down a book and read to us—sitting on two stools at his feet. It was often the Spectator or Rambler that he chose for this purpose—sometimes Blair's Sermons, which he considered pure English as well as profitable reading. In about half-an-hour we said good-night. A servant always came for our candle and took it to him that he might know that we were snug in bed."

"I think it was about the end of 1836, when William was twelve, that James and William made electrical machines for themselves, having become much interested in the study of electricity at the natural philosophy class. James's machine was larger and more carefully finished than William's, but William's, though rather rough, served every purpose to his own satisfaction. They made them entirely themselves. The chief thing that I remember is the frequent shocks to which the family in general were subjected, and the collecting of electricity in their large Leyden jars. But their work was really serious, and was continually expanding. They went on to make voltaic piles and galvanic batteries, experimenting with metals and fluids, and on light and heat, and magnetic electricity. Soon William's attention was turned to the polarisation of light, and he pursued experiments in this field of inquiry with extraordinary eagerness and delight. The brothers contrived and themselves made most if not all of the apparatus they used in their experiments."

"Their happy winter workdays were pleasantly varied with summer rambles. Dr. Nichol, the famous professor of astronomy, had taught these classes in natural philosophy during the illness of the professor, and in summer he took James and William a two or three days' ramble over the volcanic region of the Siebengebirge, climbing the Drachenfels on their last morning."

All science was their province. Lord Kelvin always claimed that natural philosophy comprehended all the sciences.

"Before setting out on our travels in 1840," his sister writes that "William had got Fourier's 'Théorie analytique de la Chaleur' from the college library, and when studying the book one day he suddenly sprang from the stool on which he was sitting and excitedly exclaimed, 'Papa, Fourier is right and Kelland is wrong.' Our father was rather incredulous, but on examination he found that in the points in which Kelland had declared Fourier mistaken it was Kelland himself who was mistaken and not Fourier. He made the boy write an article for the Cambridge Mathematical Journal, and sent it to Gregory, the editor. It was shown to Kelland before it was published. At first he was very much annoyed, but after some expressions had been altered he was satisfied to let it appear. I may add that Kelland became very friendly with William, and as long as he lived the friendship continued."

In 1841 William went to Cambridge, and the story of his life there is well known.

"A brilliant university career was before him. He was also distinguishing himself as an oarsman. A nice second-hand 'funny' came in his way, which he did not lose the opportunity of securing. It was 27 ft. long, painted blue, and bordered with a band of gilding. It was decked or covered all over except a hole in the middle, where the rower sat, and it was so light that William could carry it himself if need were. He called it the 'Nautilus.' He became as enthusiastic in boating as he was in everything he set about, and he won many prizes in the races. Like a jockey, he used to regulate his food so as to form good strong muscle without increasing his weight. . . . When he won the Silver Sculls, it was better, he declared, than winning an examination."

The story of his second wranglership and subsequent first Smith's prizemanship has often been told. When the first list came out he writes to his sister that the principal thing he cared about in the result was the disappointment he was afraid papa must feel, "as I am afraid he had rather raised his hopes about it, though I tried to keep him from expecting too much before the examination, as I knew the uncertainty."

Next year came welcome compensation. At the age of twenty-two William was elected professor of natural philosophy in Glasgow, to the chair which he made so famous during the half-century of his occupation. It was delightful, for his father, now his colleague, was becoming frail. He died of cholera in Glasgow two years and a half later. But he had seen in his declining years the splendid outcome of his long life-work. James Thomson's numerous text-books were excellent in their day. They had an enormous circulation, and were of the utmost service in the education of the time. But his greatest work was his teaching of his own family. While his most enduring monument is the splendid fame of Lord Kelvin and his elder brother, James Thomson, he did work not less memorable in shaping and developing the beautiful lives of all the six children, to whom he was father and mother in one. It was in that warm and loving home that Lord Kelvin and his brothers and sisters found the intellectual and moral nourishment that made them what they came to be in their day and generation. W. J.

PROTOPLASM IN HARNESS.

Les Zoocécidies des Plantes d'Europe et du Bassin de la Méditerranée. By Dr. C. Houard. Two vols. (I. 1908, II. 1909). Pp. xvi+1248. (Paris: A. Hermann et Fils.) Price, two vols., 45 francs.

GALLS on plants, in at least the more conspicuous forms, must have been known to man from a very early period in his history, and the presence in them of living animals might have been expected to suggest inquiries as to their source and relation to plants, yet even after Malpighi had published the results of his study of various galls, and had been followed by Reaumur in his admirable "Mémoires," the interest in those curious growths long remained limited to a very few. To botanists they were little more than excrescences on, or defects of, plants, lessening their value as specimens, while zoologists were rarely attracted to the study of the makers, which belonged for the most part to mites, nematode worms, midges, and other groups difficult to study, and little attractive in themselves.

But the latter half of the nineteenth century was marked by an almost sudden outburst of activity, about 1870, led by Drs. F. Thomas, D. von Schlechtendal, F. Löw, G. Mayr, and others, resulting in numerous papers filled with descriptions of previously unknown galls, and gall-makers, and with life-histories disclosing new relations between plants and animals, as well as new cycles of development of the animals. Such discoveries as the surprising dimorphism so general among the Cynipidæ that gall the oaks attracted keen interest, which showed itself in an increase of workers, and in a more and more rapid advance in the study of galls, especially in faunistic researches, and in more accurate determinations of the gall-makers and of the influence on one another of host and parasite.

The diversities in structure among galls (the alterations induced by the gall-producers in some cases amounting only to slight enlargement of the parts involved, while in others they result in bodies of complex nature and definite specific forms), and the systematic relations among the numerous gall-bearing plants, and also among the gall-producers, support the belief that the power to affect the protoplasm so as to lead it to produce structures useful to the gall-makers has been acquired independently by numerous organisms (plants as well as animals), in widely different grades of development. If that is so, it seems reasonable to expect that power to control the activity of protoplasm will, at least to some extent, be acquired by man, and may produce results of great value. Although as yet experiments have thrown little light on the artificial production of galls, there is a very attractive field open for research in this direction.

Since 1870 an extensive literature has appeared dealing with galls, dispersed so widely that much of it was almost beyond reach of even keen students in this field. In 1858 G. von Haimhoffen estimated the known galls of Europe at from 300 to 350. In Kaltenbach's "Planzenfeinde," issued in 1873 and 1874, the galls of Central Europe formed by insects, and by a few mites, were described under the host-plants; and from 1890 to 1895 D. von Schlechtendal issued a catalogue of the galls of animal-origin then known to occur in Germany.

In 1901 appeared two works giving brief descriptions of the galls of Europe and of the Mediterranean area, Kieffer's "Synopsis des Zoocécidies d'Europe," and Darboux and Houard's "Catalogue systématique des Zoocécidies de l'Europe et du Bassin Méditerranéen." These were most welcome, and stimulated research so greatly that a new catalogue had already become necessary when M. Houard supplied the need by his latest work, "Les Zoocécidies des Plantes d'Europe et du Bassin de la Méditerranée." Based upon the "Catalogue," and covering the same area, comparison of the two shows remarkable progress during the few years that elapsed between their dates of issue. Such a comparison is a little hindered by the host-plants being arranged in the earlier list in alphabetical order of the generic and specific names, while in the later they are in families, these following the order in Engler's "Pflanzenfamilien," while within each family the genera and species are grouped after Nyman's "Conspectus Floræ Europeæ." The advantages derived from the re-arrangement of the host plants beside their allies far outweigh those of the alphabetical arrangement.

The comparison between the individual hosts in the two lists shows very careful revision of the descriptions common to both, the omission from the second of some forms included in the first, the definite reference to their makers of numerous galls previously of unknown or doubtful origin, and the addition of many recently discovered galls, some on plants already known to bear galls, others on new hosts. A rough indication of the advance is given in the rise of the marginal numbers attached to the galls from 4169 to 6239; but perhaps a truer value is afforded by the increase of the host-plants in much the same proportion, and of the known gall-makers from 1072 to 1366 species, the increase being especially large among the Curculionidæ (beetles), the Cynipidæ (gall-flies), the Cecidomyidæ (gall-midges), and Eriophyidæ (gall-mites). Numerous additions have been made to the very useful illustrations scattered through the book.

An important addition is a bibliography of the literature on galls, which, though not complete, is the best that has yet been published, and will be found most helpful as a guide, while its value is increased by references to it under each gall; and the countries in which the galls have been found are also indicated very briefly, yet simply. Under each host-plant the galls are arranged on the same method as was employed in the "Catalogue systématique," viz., terminal galls of fruits, flowers, stems, and buds, followed by lateral growths on roots, stems, branches, leaves, &c. In most cases this method makes it possible to ascertain the name of any gall without serious difficulty; but on some of the oaks and a few other plants the forms are so numerous as to lead to further subdivision of the groups by subordinate characters.

The arrangement of the plants in families has allowed a brief but suggestive outline of the leading features of the galls characteristic of each family, and of occasional suggestions for inquiries.

Careful indexes of the host-plants and of the gall-makers add greatly to the usefulness of the book, and the typography is excellent. It is, in a very literal sense, indispensable to all students of galls, while those interested in the problems as to the nature of living matter and its responses to stimuli will find in its pages much matter for further investigations.

ELECTRICITY ON THE FARM.

Électricité agricole. By A. Petit. Pp. 424. (Paris: J. B. Baillière et Fils, 1909.) Price 5 francs.

THIS book is one of the sixty volumes of the "Encyclopédie agricole," published under the editorship of M. Wery, the scope of which is well summed up in the introduction:—

> "Extraire de notre enseignement supérieur la partie immédiatement utilisable par l'exploitant du domaine rurale et faire connaître du même coup à celui-ci les données scientifiques définitivement acquises sur lesquelles la pratique actuelle est basée."

It is in no sense a popular exposition of the principles of electricity, but is rather written for the intelligent farmer who knows something about electricity and also about engineering, and is enterprising enough to investigate the merits of a new suggestion.

The first chapter is devoted to a recapitulation of the general principles and the system of units employed. No attempt is made to dispense with technical expressions; "connaître le vocabulaire d'un art, c'est déjà connaître cet art." The modes of transforming mechanical into electrical energy are then discussed in a very interesting chapter, the sources of energy dealt with being water power, steam, oil, and wind. Of all these wind would be by far the best if electricity had to be generated on the farm itself, but the difficulties are considerable. Attempts have been made in this direction particularly by M. La Cour in Denmark, whose trials are perhaps the most complete yet made, and who has demonstrated the possibility of utilising wind if there is also some subsidiary source of power. But the subject is by no means exhausted, and the utilisation of the energy of the wind still remains one of the most fascinating problems in agricultural engineering. The transmission of the current is next described. In this chapter, as in the preceding one, there are a number of diagrams to illustrate the principle of the apparatus, besides a good deal of information that will be useful when anything goes wrong. These chapters take up half the book.

The author then comes to the very important subject, How can electrical energy be utilised on the farm? The two applications developed in detail are the driving of engines and lighting. Its use for driving the machinery in the farm buildings, the chaff-cutter, the pulper, and so on, is obvious, but the author goes still further and describes a number of applications which as yet have only rarely been made. Some forty pages are devoted to electrical ploughing, the first attempts at which were made so far back as 1879, although as a practicable method nothing was done until 1894, when a start was made both in Italy and in Germany. The methods are almost exactly the same as for steam ploughing; indeed, the idea is taken direct from the steam plough but electricity is substituted for steam as the hauling power. In one system there are two electric motors at opposite ends of the furrows hauling the plough; in the other an anchor is used and there is one motor only. The problem here is really very simple; if steam ploughing is known to be beneficial electric ploughing will be equally so, and the question resolves itself solely into the relative cost of the power. Indeed, this statement holds true of most of the applications recommended by the author. His electrical threshing machine, for instance, is the ordinary machine driven by electrical power, so also are the refrigerating machines, pumps, and sawmills.

The application of electricity as a source of light affords a great deal of scope for the author's ingenuity, since many of the farm operations, such as the milking and feeding of dairy cows, have to be carried out before daylight during part of the year. Suitable lamps are suggested for the various buildings.

There is also a useful chapter on treatment of accidents caused by electricity and precautions to be taken in order to avoid accidents. Lastly we have some well-illustrated descriptions of farms where some of these applications are in actual use. Probably to the English reader this is the most interesting chapter of all. Whether we may expect to see electricity utilised on British farms is another matter. Up to the present electricity has simply been taking the place of steam to work the old implements originally designed for human or horse labour. Probably before it comes into common use in agriculture our implements will have to be re-modelled and adapted to electrical power. In the cases described by the author water power is available or electric current is being transmitted through the district. The farmer can calculate exactly how much his power will cost him and whether it is worth while replacing the oil engine by a motor.

The book forms a useful contribution to agricultural engineering, and will make very suggestive reading for the thoughtful agriculturist.

THE PHENOMENA OF THE EARTH'S SURFACE.

Physiography for Schools. By R. D. Salisbury. Pp. viii+530. (London: John Murray, 1909.) Price 6*s.* net.

THIS book may be looked on as a reduction of the advanced course by the same author. Prof. Salisbury states in his preface that he differs from other writers on physical geography "as to the points upon which emphasis should be laid and the objects to be attained." But it would require careful reading to find out in what matters of principle this text-book differs from others by American authors, and we fancy that schools will adopt one book or the other rather from some attraction between the teacher and the author than from any preference as to mode of treatment. We miss the "cycle of erosion," and its accompaniment, the "peneplain," which have taken quite an affectionate hold upon our minds; but we meet the "mesa" and the "monadnock," and the really awkward adjective "piedmont," this last being used without explanation, and applied to certain plains as well as glaciers.

Valley-forms are agreeably dealt with as expressions of youth, maturity, or old age, and the excellent chapter on the "Work of Running Water" may be taken as typical of the first part of the book. We should not like to spare any of its numerous maps and illustrations, which bring before us all manner of details in the history of a stream; at the same time, we should like to hear more from the author, whose lines are modestly dovetailed in between them. A specially effective feature of part i. is the insertion of some twenty contoured maps in colour, often on a scale of one inch to one mile, selected from the topographic sheets of the United States Geological Survey. With this example before us, must we wait long for a European work, similarly illustrated from our British contoured maps, and also, perhaps, from the 1:200,000 sheets of the Austrian Military Institute?

The later parts of the book, on "Earth Relations," "The Atmosphere," and "The Ocean," do not lend themselves so temptingly to illustration; but numerous diagrams and charts are given, and the instruction in the text is singularly clear. Fig. 351, showing how the length of a degree is related to polar flattening, requires more thought than a child is likely to bring to bear on it. Perhaps a diagram showing how longer distances have to be traversed as we go northward, in order to shift the altitude of the pole star by so many degrees, might have been simpler, in illustration of the description on the following page. Snow crystals are named "snowflakes" in the title of Fig. 176; and Fig. 450 shows the sounding-tube, and not the line, as stated. We fear that the abrupt question to the reader, "Why not use a rope, instead of a wire, in sounding?" may be taken as a suggestion from the gifted author, and may turn the young mind in a wrong direction. But there is little to criticise in this closely-written text-book. We return to the pages on the work of rivers and of ice with special pleasure. The author thinks (p. 168) that plastic flow does not play any real part in glacier motion, and lays stress on the re-freezing of water that has sunk from above into the ice-mass. The recently published work on glacial phenomena in the Bighorn Mountains has been promptly utilised, and one of the fine cirques, though not our own favourite picture, is shown on p. 179. Chapter xix., on the relations of plants and animals to their environment, has been contributed by Dr. Cowles and Mr. C. C. Adams. G. A. J. C.

OUR BOOK SHELF.

An Atlas of Absorption Spectra. By Dr. C. E. K. Mees. Pp. 74. (London: Longmans, Green and Co.; Croydon: Wratten and Wainwright, Ltd., 1909.)

All scientific workers who have had occasion to employ colour-sensitive photographic plates during the last few years will probably have wished at some time to learn some details as to the specially great advances made in their preparation. Also for the efficient use of the plates suitable screens or colour-filters are required to equalise the action of the various colours. Dr. Mees, as director of the firm of Wratten and Wainwright, has had exceptional facilities in dealing with these matters, and in publishing this atlas he is giving others the benefit of his work. The spectra were taken on the spectrum panchromatic series of plates, which, in addition to the usual region of maximum sensitiveness in the violet, show another maximum near λ 6500 in the red, with gradually decreasing action to λ 7500. To obtain as even records as possible, two schemes were adopted:—(1) For the spectra of dyes an equalising screen of special composition, with two cells of mandarin-orange and P-nitrosodimethylaniline, was used with a Nernst lamp; in the case of special dyes the spectra were photographed in two sections for convenience; in front of the slit a wedge-shaped cell was fitted containing the dye solution, with a similar cell filled with pure water the opposite way to compensate for any prismatic effect. By this means the light passed through varying thicknesses of absorbing medium from end to end of the slit, and the resulting spectra show curves bounding the absorption bands which indicate graphically the change in absorption with varying thickness of dye. (2) For the spectra of the colour-filters the wedge cell could not be employed, and in its place a black wedge of specially prepared glass was used. This gave a range of intensity from 1 to 10,000.

The atlas contains reproductions of the spectra of 170 dye-stuffs, most of them obtained from the Hœchst Farbwerke, and of 76 colour-filters prepared by Messrs. Wratten and Wainwright for various purposes, which are clearly stated. All the photographs are scaled in wave-lengths, so that by mere inspection the exact range of any absorption may be ascertained. A concise index is given, including the name of dye, concentration, source, whether it is acid or basic, and a scale of numbers representing the relative stability to light. Series of monochromatic filters are supplied and illustrated, which practically isolate a very small portion of the spectrum in each case, these being suitable for work requiring great precision in the wave-length of light employed.

Physiology of Man and Other Animals. By Dr. Anne Moore. Pp. xiii+212. (New York: Henry Holt and Co., 1909.) Price 80 cents.

This little book is intended for the use of children in schools; about half of it is devoted to elementary physiology, and the remainder to elementary zoology. The author has the gift of putting things clearly, and in a manner likely to interest the young. She, however, very soon gets out of her depth, and often makes mistakes of the most elementary nature. This is particularly noticeable when she speaks about the nervous system or strays into the region of chemical physiology. There is no clear distinction made between the central and the peripheral nervous system, and no mention made of the functions of the brain as the organ of mind; the depressor nerve is stated to cause slowing of the heart, and the sympathetic nerves, we are told, received their name because of their extreme sensitiveness.

Her definition of osmosis would not be acceptable to any physicist or physiologist; she has not even grasped the distinction between internal and external respiration. We are told that carbon dioxide stimulates the respiratory *muscles* to action; that the secretion of the sebaceous glands is a part of the secretion of the sweat glands; that lipase is the most important ferment of the pancreatic juice; that peptones are absorbed and pass to the liver; that fats are hydrocarbons; and that the formula for starch is $C_6N_{12}O_6$. Such examples of glaring errors are quite sufficient to show that the book cannot be recommended as a safe guide to those who have passed childhood, and even for children it seems a pity that some degree of exactness should not be aimed at.

Deutsche Südpolar-Expedition, 1901–1903. Bd. ii. Geographie und Geologie. Heft 5. Pp. 348–410; pls. xxviii–xxx. (Berlin: Georg Reimer, 1909.) Price 8 marks.

The German South Polar Expedition called for a few hours at the islands at St. Paul and New Amsterdam, and though in so short a visit but little fresh information was obtained, one of the valuable by-products of the expedition is a useful summary and discussion of all that is known about these islands. New Amsterdam was discovered in 1522 by Sebastian del Cano, who commanded Magellan's expedition after his death at Manila. Both islands are French possessions. They are both solely volcanic, and rise from a common base. New Amsterdam is composed only of basalt, while St. Paul consists of basalt with some rhyolite tuffs and obsidian. The memoir on the geography of the islands is by Dr. von Drygalski, on the geology by Philippi, and on the petrology and the relations of the lavas to those of Kerguelen, Possession, and Heard Islands by Reinisch. E. Vanhöffen contributes a catalogue of the flora and of the fauna, which consists only of insects, myriapods, spiders, tardigrades, crustacea, rotifers, &c. The memoir has three excellent plates illustrating the scenery and volcanic features.

Les Progrès récents de l'Astronomie (1908). By Prof. Paul Stroobant. Pp. 115. (Brussels: Hayez, 1909.)

Everyone interested in the progress of astronomy will welcome the appearance of Prof. Stroobant's annual summary of a year's results, and 1908 was by no means a barren year. Hale's discovery of the Zeeman effect in the solar spectrum, the Flint Island eclipse, the Lowell Observatory observations of the planets and their spectra, the discovery of J viii by Melotte at Greenwich, and the preliminary comet campaign provided by the appearance of 1908 III, are all reviewed in a fashion at once comprehensive and clear. The omissions are few, but we regret to find no mention of the McClean expedition to Flint Island. Four plates illustrate various researches, and the tables of results will be found useful for reference. Although each result appears under a general and a special heading, the addition of an index to this small volume would, we believe, enhance its value.

W. E. R.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Cross-fertilisation of Sweet-peas.

IT is unnecessary, I think, to cite more than one of the recent statements with regard to sweet-peas, though I can provide others. Sir Francis Galton in his just issued "Memories" (p. 300) writes:—

"After much consideration and many inquiries, I determined in 1885, on experimenting with sweet-peas, which were suggested to me both by Sir Joseph Hooker and Mr. Darwin. Their merits are three-fold. They have so little tendency to become cross-fertilised that seedsmen do not hesitate to grow differently coloured plants in neighbouring beds. . . ."

I must thank Mr. Francis Darwin (p. 308) for his reference to the "Cross- and Self-fertilisation." On the page he refers to Charles Darwin writes:—"Why, then, do not the varieties occasionally intercross, though this would not often happen, as insects so rarely act in an efficient manner?" and again, "Whatever the cause may be, we may conclude, that in England the varieties never or very rarely intercross." These are the views which evidently Charles Darwin communicated to Sir Francis Galton.

My point is that *now* they do intercross, and that varieties cannot with safety be kept in neighbouring beds. Mr. Wright, the superintendent of the Royal Horticultural Society's Garden at Wisley, told an inquirer in 1907, as to his experience *re* sweet-peas, that he had no doubt there was some English insect that cross-fertilised them, and that in trying new sorts the gardeners had to place the rows in different parts of the garden to minimise the risk as much as possible. Charles Darwin, in the passage referred to, says that "on two or three occasions" he saw Megachile in the act of depressing the keel, and he notes that these bees had the undersides of their bodies thickly covered with pollen. My point is that hourly every day these bees came in large numbers; their visits were not occasional, but persistent and effectual; I never saw a hive bee, although they frequently tried, successful. Megachile may, in the course of forty years, have developed the habit much more completely. The purport of my letter was merely to suggest to those growing sweet-peas that there is no security that they will be self-fertilised if Megachile be frequent.

I should like to add that "The Original π" is by no means the first π who has contributed to the columns of NATURE! The π's are a large and talkative species.

π.

The Village Institute and its Educational Possibilities.

THE growth of social life in villages during the last few years has been fostered by the erection of village institutes, halls, and reading-rooms, and yearly such institutions are becoming more numerous. Has the educational life of the village been fostered by their growth?

The majority of these institutions cater for games and recreation, together with a supply of reading matter of the daily paper and monthly magazine type. The presence of the latter indicates a desire on behalf of the management or the donor of the institute to devote at least part of the work of the institute to educational purposes. In many institutes the reading-room is little frequented and has the least share of the members' time, whereas the billiard-room, where long visits are the rule, invariably presents a scene of congestion.

To a certain extent the village institute is a replica of the mechanics' institute of the towns and urban districts; both serve as a meeting place for members, and supply opportunities for recreation and self-improvement to them.

The mechanics' institutes were, in their earliest days, the housing place of evening classes in science, art, and languages, but the growth of continuation education has led to the general abandonment of the mechanics' institutes for systematic class instruction and the provision of special buildings. Courses of lectures of a more or less educational character still remain at the mechanics' institutes—remnants of their early educational efforts. The mechanics' institute is a model upon which the village institute might shape its policy and methods, so becoming a centre of educational activity.

As a result, we find that several village institutes, like their town compeers, give courses of lectures. Such subjects as agriculture, horticulture, poultry-keeping, bee-keeping, and other rural industries are so treated, but, generally speaking, the village institutes have never attempted to take up the work of systematic evening education, as the mechanics' institutes did, fitted to the environment of the villager.

The future of an individual is as much a problem for the "powers that be" in a rural community as it is in the urban district, town, or city. This future is not thoroughly and properly catered for by providing the individual with games and recreation to the exclusion of provision for craft-work and intellectual training for his daily work. Why should not the village institute help in the intellectual development of villagers, keeping them mentally elastic and manually efficient by suitable educational work?

If the institute cannot provide suitable educational provision on account of lack of funds, it certainly should not, by its rules of membership or otherwise, be an obstacle in the way of other institutions which take up evening classes.

The younger members of rural communities, as in towns, after leaving day school generally display no further interest in their own education, and their elementary education equipment begins to rust.

In the towns we appeal to the employer to look after the welfare of the youth by asking him to see they attend the evening school. In the villages the same appeal may be made by way of the village institute. The appeal in each case would cease if continuation work became compulsory, but as at present compulsion is not a part of either political party's programme, we must look to other means. It may be said there would be no resting and rusting of the villager if there were an evening continuation school in the village, a statement which brings one to the *raison d'être* of the present letter on village institutes.

The village institute has usually no restrictions concerning the admission of a youth when he applies to become a member. It would not be necessary to advocate a restriction if institute managers had, as a condition of membership, told the would-be member that the institute would be closed to him on those nights the evening school was open. It would not be too drastic to tell the would-be member that up to eighteen years of age he would be expected to attend the evening classes held in the village. In small villages, where the number of available students for an evening school is small, the village institute should render all the help it can. A leading educationist stated before the recent Consultative Committee on Attendance at Evening Schools that there was a club where no boy was allowed to remain a member unless he attended the evening classes two nights per week. The village institutes might take up a similar definite position where evening schools are in existence.

The foregoing suggestions are made because the institute, by providing games, not only threatens the existence or birth of an evening school, but cultivates in its young members no sense of responsibility either to themselves or to the community. A curriculum of pleasure alone should be far from satisfactory for the leaders of village activity.

It may be said that an institute cannot afford financially to cripple itself by the adoption of the foregoing suggestions. My reply is that managers would find that such a regulation, prospective in nature, would not reduce applications for membership. Temporarily there might be a little resistance to the conditions, but in time applicants would become educated to the benefits of such a regulation and recognise it, as they do the payment of a fee. The authority managing the evening school might transfer the fee from the school to the institute if the student made a satisfactory percentage of school attendances. Thus the student would not be mulcted in two payments, one for the school and another for the institute.

It does appear plain that the village institutes have a fine opportunity for giving encouragement to continuation rural education; they not only miss the opportunity, but, at the same time, unwittingly are the cause of there being no demand for an evening school. Opportunities for the village youth to spend aimlessly and uselessly all their spare time are to be deprecated.

In one West Riding village the influence of the opening of a new institute was shown by the total exodus of the members of the existing evening school. Even the moral obligation to complete their attendances, so as to save financial losses upon the school, failed to bring them back again. The billiard-ball was rolling, so opportunities for the making of more fit citizens were sent flying. The result was not a moral triumph for the ex-students.

May one suggest that in the future some donor of an institute, or someone who by their contribution has made it possible for trustees to lease an institute at a nominal rent to a committee of management, should insert a proviso in their deed of gift that younger members of the institute are to attend continuation educational work at the village school? Such a proviso might be open to elimination if found, after an extended trial, to be prejudicial to the institute's success.

There should be an educational side to every village institute; it might be an attached rural association or club for the further advance of rural interests. Such an association might hold meetings periodically for discussions upon general agricultural matters. Samples of manures and feeding stuffs, along with a consideration of current values and prevalent adulterants, are important matters, and should be undertaken by the suggested rural club. The leaflets of the Board of Agriculture would be suitable for elucidation and discussion; their distribution could be carried out by the club.

Village halls have been in the past the centre of the arts and crafts movement; in some parts of the country they are yet. The development of handwork in the elementary schools of the rural districts should again revive the use of the village hall. Such a revival requires funds. The Board of Education and local authorities place at the disposal of committees doing educational work of a manual nature liberal grants. Some of the wealthy trade guilds might be disposed to find funds for a village development of arts and crafts if the work had an industrial basis. In this way might be developed in the village, as in Germany, a large number of small workshops going hand in hand with agriculture.

The village institute and evening school would not become competitors by both taking up educational work; they would become helpers. Admission to the institute's higher work should preferentially be given to those who had thoroughly prepared themselves for it by a satisfactory course of preparatory work at the evening school. In short, the institute would be regarded as the technical school of the village, giving, amongst other work, practical and theoretical instruction on the greatest of all industries—agriculture.

JOHN B. COPPOCK.
(Organiser for the Rural Districts of
the West Riding of Yorkshire.)

Education Department, County Hall, Wakefield.

Avogadro's Hypothesis (or Law).

IN Prof. Tilden's "Life of Mendeléeff" in the current number of the Journal of the Chemical Society, I see that he refers repeatedly to the "law" of Avogadro. Sir William Ramsay, in his "Modern Chemistry," speaks of it as a "hypothesis," and this has surely been, until recently, the practice of chemists.

I think there is a growing tendency to speak of it as a law. This, doubtless, arises from the strong confirmatory evidence provided by modern physical chemistry. It is desirable, in the interests of students and of exactitude in scientific nomenclature, that some decision should be come to as to which term should be used. This may necessitate very careful definition.

A discussion of this matter, in which teachers will give reasons for their choice, should prove of value.

S. H. WOOLHOUSE.

Parmiter's School, Approach Road, Victoria
Park, N.E., January 17.

"A Japanese Priest in Tibet."

WHATEVER may be the demerits of Mr. Kawaguchi's "Three Years in Tibet," reviewed in NATURE of January 13, the title of the book is, according to the Eastern habit of reckoning, quite accurate. Mr. Kawaguchi spent part of 1900, all 1901, and part of 1902 in Tibet—three years. A child in Japan, if born on December 31, begins his second year on January 1, and on the succeeding New Year's Day may be regarded as having lived for three years, although he may be only 367 days old!

C. G. KNOTT.

University of Edinburgh, January 17.

STANDARD MEASUREMENT IN WAVE-LENGTHS OF LIGHT.

THE employment of the principle of the interference of two rays of monochromatic light, derived from the same source, one retarded behind the other by having to traverse a longer path, for the production of rectilinear interference bands constituting a scale of half-wave-lengths, has now been brought to such perfection that this highly refined scale may be used for the measurement of short distances or small movements of any description whatsoever. The accuracy is absolute to the tenth part of a scale division, the twentieth part of a wave-length of light, and is actually measurable with the most ordinary micrometer to the one-hundredth of a scale division, corresponding to the two-hundredth part of a wave-length. Now a wave-length of even the grossest radiations employed, those of red light, derived from either cadmium vapour (0·0006438 mm.) or hydrogen (0·0006562 mm.), is a forty-thousandth of an inch, so that the measurable unit is an eight-millionth part of an inch.

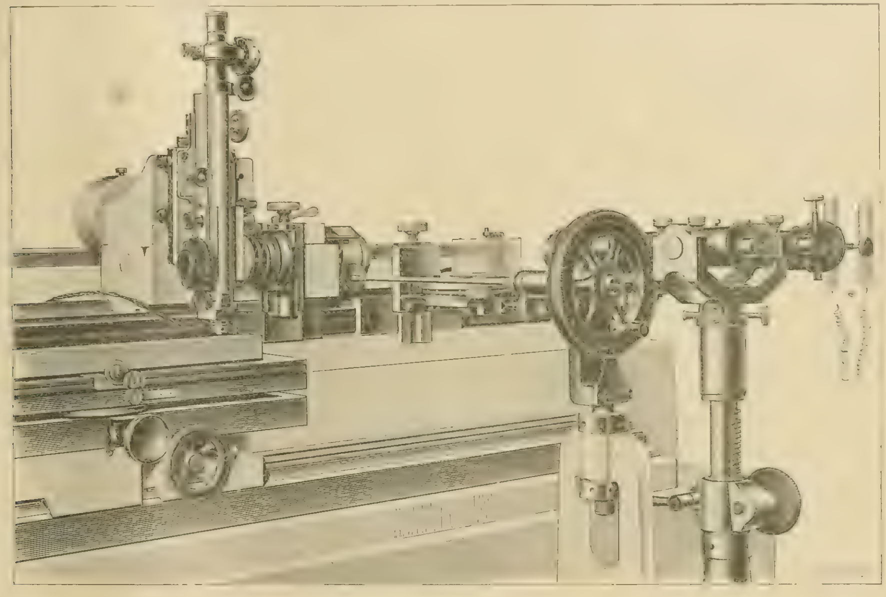
The finest trustworthy measurement by mechanical means (such as the Whitworth machine) or micrometric devices (such as the most refined thickness measurer) is the one-thousandth of a millimetre, or the twenty-five-thousandth of an inch. Moreover, the amount of possible error with either of these mechanical methods of measurement or the interference method is from one to two units of the respective scales. Hence the interference method is only subject to a possible error of one three-hundred-and-twentieth the magnitude of that to which the mechanical mode of measurement is liable.

The interference method was first seriously employed by Fizeau, who utilised it for the determination of the thermal expansion of crystals and other small bodies. It was materially improved by Abbe and Pulfrich, and more recently both for the same crystallographic purpose and for general purposes by the writer, who has also extended its use to the measurement of the modulus of elasticity of crystals and small bodies or small quantities of substances in general.

It will be remembered also that Prof. Michelson, of Chicago, has recently adapted his entirely different mode of producing interference fringes, in this case circular, to the determination of the number of wave-lengths of red cadmium light, which he has proved to be the most homogeneous of all radiations yet known to us, in the French metre. By employing a graduated series of glass-plate *étalons* or intermediate standards, each double of the preceding one, commencing with a basal one of half a millimetre in which the actual number (1212) of half-wave-lengths was counted, the number of wave-lengths of red cadmium light in the metre was eventually found to be 1,553,163. This number has since been confirmed by the independent method of Fabry and Perot, in which circular fringes are also produced.

Three years ago the writer was invited by the Standards Department of the Board of Trade to adapt his interferometer to the purposes of a wave-length comparator of measures of length, and a memoir recently published in the Philosophical Transactions of the Royal Society (Phil. Trans. A, 1910, vol. ccx., p. 1), with the consent of the President of the Board of Trade, describes the instrument, which has now been installed in the Standards Office. The memoir also comprises an appendix concerning the possible employment of wave-length rulings on metal as defining lines on standard bars, with suggestions for their use along with the interference bands of the interferometer, in an original method of determining the total number of wave-lengths in the British yard.

A general view of the interferometer and one of the duplicate microscopes of the comparator, together with sufficient of the bar-carriage to enable some idea of the whole apparatus to be gained, is given in the accompanying illustration.



Central part of comparator, showing interferometer.

The whole instrument is mounted on a large stone block, resting on isolated concrete foundations. On a small stone pedestal, similarly isolated, in front of the large block, rests the pedestal of the autocollimating telescope and attached Geissler tube of the interferometer. In the common focal plane of the telescope objective and eye-piece, opposite the junction of this main optical tube with the rectangularly attached side-tube carrying the Geissler tube, a small totally reflecting prism is arranged, half covering the focal aperture. A still smaller rectangular stop or opening in a plate in front of and almost touching that one of the perpendicular prism faces which is directed towards the objective, and lies in the focal plane very close to the edge, dividing the closed half from the open half, is the effective source of the interfering light; the rays from the Geissler tube, received on the other face of the right-angled prism, are arranged to fill this stop after reflection from the hypotenuse of the prism. The rays proceed from the stop to the objective, which they are arranged to fill with light, and thence pass out of the telescope as parallel rays, in the path of which the dispersion and interference apparatus is placed. The rays return to the telescope from the latter along practically the same path, but after re-entering the telescope, instead of returning to the little rectangular stop, their origin, they are deflected just sufficiently to one side to form an image of the stop, the same size as the original, in the open semicircular aperture of the focal plane, within a couple of millimetres of the real stop. This closeness to identity of path of the outgoing and incoming rays, and consequent normal incidence on the reflecting glass surfaces of the interference apparatus, is largely responsible for the magnificent field of parallel straight-lined interference bands which the author's interferometer affords, for it fulfils an essential condition for perfect interference.

With the ordinary eye-piece in position, the images of the stop reflected from the various surfaces of the interference apparatus can be focussed, adequately magnified, and viewed during their adjustment to the theoretically ideal positions. But when this eye-piece is replaced by a special one consisting of a Ramsden micrometer combined with an additional lens between the latter and the focal plane, the telescope is converted into a low-power microscope, which focusses simultaneously the interference bands, a little silvered reference ring in the centre of one of the two surfaces reflecting the interfering light, and the micrometer spider-lines. There are two parallel vertical spider-lines; one is adjustable by the left drum-head of the micrometer, so as to be able to set it at any convenient distance from the other in order to include a single band and most of the reference ring between them; and both are moved together by the other (right) measuring drum, in order to be able to determine the band-width and any fraction of a band which may have passed the reference centre.

The dispersion apparatus consists of a Hilger constant-deviation prism, which enables the desired spectrum ray to be isolated from all others, and that alone delivered to the interference apparatus. The rays are deviated exactly at right angles by this prism towards the interference apparatus, the surfaces of which they strike at normal incidence, after which they return through the constant-deviation prism (thus securing double dispersion) to the telescope. The prism is mounted on a divided circle, so that it may be calibrated for the delivery of light of any desired wave-length, if desired, and has numerous adjustments. Such calibration is not essential, however, as the particular image of the origin-stop in the colour corresponding to the spectrum bright line of cadmium or hydrogen can be adjusted visually on removal of the front lenses of the Ramsden eye-piece.

The interference apparatus consists of three circular and thick glass discs, the third of which is of black glass polished an absolutely true plane on its outer surface, which is one of the two important surfaces concerned in the production of the interfering light. It is ground on the back surface, by which it is attached in an adjustable manner to the right microscope of the comparator, the movement of which it is to record. The other two are larger discs of colourless glass, identically similar, the two truly plane surfaces of each disc not being strictly parallel, but inclined at the minute angle of 35 minutes. The left surface of that one nearest to the black glass disc is the second surface concerned in the interference, and approaches the black glass within a millimetre; the second is a duplicate one, merely introduced on the right of it to correct for the slight dispersion produced by the 35′ of inclination, the two being set oppositely as regards the direction of the wedge. The 35′ inclination is just adequate to deflect out of the field of the telescope the reflection from the other (right) surface of the left colourless disc, and both images from the countervailing disc are got rid of by a slight tilt in the rectangular direction. All the many adjustments required are provided for in the mounting of the two colourless discs, on a separate carrier sliding along the face of the upper V-and-plane bed of the comparator.

The apparatus as described up to this point is the interferometer.

The comparator consists of two V-and-plane beds, nearly 7 feet long, of specially homogeneous cast-iron, and worked truly plane with consummate care, together with their contents; they are arranged step-wise, one on the top of the stone block, and the other 7½ inches below and in front. On the upper one slide the two duplicate microscopes, and on the lower one the standard-bar carriage and accessory fine-adjustment fittings. The carriage is given a longitudinal motion, a transverse motion adequate to bring either of the two bars to be compared under the microscopes, as well as fine adjustments for azimuth, height, and level, thus enabling the defining marks on the bars to be readily focussed without touching the microscopes if it is so desired.

Each microscope is carried on a solidly constructed slider on the V-and-plane bed, by which its coarse adjustment for position is effected. The microscope-bearing bracket is not, however, fixed directly to this slider, but to a second one sliding over the first, also with V-and-plane contact, and with the further control of the movement of a cylinder within a cylindrical boring. The fine-sliding is effected by means of a most carefully made screw of fifty threads to the inch, on which the success of the instrument depends, and which carries at its outer end a large milled head for hand rotation, and a worm-wheel of 100 teeth gearing with an endless screw, which can either be rotated by hand by means of a milled head or by means of a shaft and a large wheel seen in front in the illustration. One complete rotation of the latter corresponds to the movement of the microscope and the black glass interference disc to an extent which causes the passage of fifteen interference bands past the reference centre. More than an inch of movement of the circumference of the wheel is necessary to effect the passage of a single band. Two-thirds of the dead-weight of the microscope and slider are taken up by four spring pistons, and the movement of the slider by the screw is only a push in either direction against the walls of a recess in the free slider, there being absolutely no strain anywhere. Hence this movement of the microscope is not only an excessively fine one, but also so steady that the bands pass with a precision which leaves nothing to be desired, and each band may be held for any length of time for counting purposes.

Each microscope is provided with a micrometer eye-piece, with spider-lines arranged as in the interferometer. The fine adjustment is made exceptionally steady and regular. Two sets of objectives are provided, one pair for observing the defining lines in the countersunk wells near the ends of standard bars, with a magnification of 150 diameters, and without penetration of the well by the objective, and the other set for use with the wave-length rulings.

The defining lines, of whatever character, are illuminated (with "critical illumination") by the brilliant image of a distant Nernst lamp, with the aid in each case of a little reflecting prism, a collimating lens, an iris diaphragm, and a glass-plate mirror above the objective, all provided with fine adjustments. This avoids all heating effect on the bars, and the last traces of heat rays are filtered out by a thick water-jacket in front of the lamp and its beam-parallelising lenses. The illumination of the wave-length rulings one-forty-thousandth of an inch apart is excellent with the 1/12th inch dry objectives employed, and the definition truly surprising.

The temperature of the whole comparator room is maintained at the official temperature, 62° F., entirely electrically, both as regards artificial heating and the thermostat, which is original. So sensitive is the latter that the entrance of a person into the room is immediately followed by the extinction of one of the heating lamps to compensate for the extra warmth introduced.

The finest defining lines yet employed on any line-measure bars are those on the platinum-iridium copy of the imperial standard yard. Yet even each of these has a thickness equivalent to fifteen interference bands. The defining lines on the imperial yard itself are three times as coarse. Hence we have now arrived at that stage in the competition between defining lines and refinement of measurement when the latter has far surpassed the former. It was for this reason that the writer took up the investigation of wave-length rulings, with the idea of their possible use as defining lines commensurable with the increased refinement of measurement. Mr. H. J. Grayson, of Melbourne, whose wonderfully fine rulings have recently been much discussed in microscopic circles, has kindly made a number of rulings of 1/40,000th inch fineness, which preliminary experiments indicated as feasible for the required purpose, on polished speculum-metal and platinum-iridium, which appear, particularly the former, perfectly satisfactory. The forty-thousandth of an inch being the wave-length of red hydrogen or cadmium light, the distance between two lines ruled at this interval corresponds to only two interference bands. With the 1/12th inch dry objectives the lines, moreover, are as cleanly cut as spider-lines, and the thickness of a line is less than half a wave-length. Five such lines are ruled in succession, the central one being considered as *the* defining line. A strong finder-line is ruled on each side of the five, and two other strong ones at right angles in order to localise a central part of such a system. It appears perfectly feasible to carry out a stepping-off process for the counting of the total number of wave-lengths of cadmium red light in the British yard, in which such rulings would take the place of the glass plates of the Michelson or Fabry and Perot *étalons*, a base line of the thirty-second part of an inch being first actually counted in bands with the aid of the interferometer, between limits defined by two such systems of rulings. The final fraction of every stage in such a process could be absolutely checked by the interferometer in all cases where Michelson found it possible to do so, that is, so far as interference bands are still visible, about four inches; and, as it has already been proved that the accuracy with the rulings is almost as great as with interference bands, this checking ceases to be as imperative as when only the coarse existing defining lines are available. Hence, the future before these rulings appears likely to be both interesting and important.

A. E. H. TUTTON.

SOME NEW NATURE BOOKS.[1]

(1) IN this series of pleasantly written essays Mr. Larken gives an account of some of those features of English (and Scotch) country districts which usually appeal to nature-lovers. The author's habit of passing lightly from one topic to another but distantly connected with it produces a certain disjointedness of style and some needless repetitions, but, taken as a whole, his book is quite good to read, and his knack of interesting one in a disputed point and then abruptly leaving it unsettled is well calculated to stimulate personal observation on the part of his readers.

When attempting to draw conclusions himself, however, he is less happy, being prone to derive the inherited instincts and habits of an animal directly from the experience of its ancestors. Moreover, one has rather frequent cause to doubt the accuracy of his statements; for example, anyone familiar with the Caligidæ, and the tightness with which they can adhere, either in or out of the water, even to the smooth sides of a glass dish, will certainly question the remark on p. 219 that a salmon "leaps . . . into the air for the purpose of getting rid of the sea-lice which are attached to him." That "the Brimstone is a genuine child of spring" in contrast with the hibernating Vanessid butterflies (p. 244) is contrary to the experience of other entomologists; and "Humming-Birds of New Guinea" (p. 192) should presumably read "Sun Birds of New Guinea," for humming-birds are confined to western America and its islands.

The book is illustrated with a profusion of excellent plates, chiefly from photographs. As the greater part of it is concerned with ornithological matters, it is not surprising to find that the majority of the illustrations are of birds' nests. The plate of the comma butterfly, which we reproduce, is one of a short series of admirable insect studies.

(2) These four little volumes will be useful to those who wish to interest children in natural history. They treat of the varied aspects of their several subjects in a clear and interesting manner, and are well illustrated by plates (both coloured and from photographs) and by figures in the text. One hesitates to criticise such admirable books at such a low price, but the value of some of the plates would certainly be increased if they could be brought more closely into connection with the chapters which they illustrate; and where this is impossible reference should be made to them in the text. Some statement of the scale of many of the figures would make these much more useful; in chapter ix. of "The Common I Know," where this is particularly needed, it could easily be made by the insertion beside each figure of a line indicating the length of the living specimen. On p. 30 of the same volume the association of two figures of plants drawn to different scales is apt to mislead. But even as they stand we are far from wishing to condemn the figures. Apart from size, they show clearly the salient characters of the objects described; the reproduction of the photographs has been beautifully executed, and the coloured plates are wonderful at the price. We can thoroughly recommend the books for (elementary) school use.

Comma Butterfly. From "Leisure Hours with Nature."

(3) This "collection of literary extracts to accompany a course of nature-study" includes prose and poetry, with a variety of subjects ranging from Ruskin's "Plants" and Thoreau's "Brute Neighbours" to fairy stories such as "The King of the Vipers" and Ruskin's "Visit from the South-West Wind." Several of the extracts are old favourites

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[1] (1) "Leisure Hours with Nature." By E. P. Larken. Pp. xv+263. (London: T. Fisher Unwin, 1909.) Price 5*s*.

(2) "The Wood I Know"; "The Meadow I Know"; "The Stream I Know"; The Common I Know." Edited by W. P. Westell and H. E. Turner. Pp 77 each. (London: J. M. Dent and Co., 1909.) Price 8*d*.

(3) "The Ruskin Nature Reader." Intermediate Book. Selected and edited by G. R. Bennett. Pp. x+180. (London: J. M. Dent and Co., n.d.) Price 1*s*. 6*d*.

which have long figured in school "readers," and the others, though less familiar in this *rôle*, are none the less fitted for it. The book is nicely illustrated, and concludes with a short glossary of the rarer words and phrases found in the extracts. It may be recommended for class purposes.

THE BOSTON MEETING OF THE AMERICAN ASSOCIATION.

THE sixty-first meeting of the American Association for the Advancement of Science and of its affiliated societies was held in Boston, Mass., December 27, 1909, to January 1, 1910, under the presidency of Dr. David Starr Jordan, of Leland-Stanford University, California. The meeting was a large one, nearly 1100 members of the association being registered, and the total number of men and women of science in attendance was not far from 2000. The number of affiliated societies was larger than usual, numbering thirty in all. The meetings were held in the buildings of the Massachusetts Institute of Technology, in certain of the buildings of Harvard University, Cambridge, and the new Harvard Medical School in Boston. These three groups of buildings are rather widely separated, and for this reason it was difficult to bring together the exact registration.

The opening session was held in Huntington Hall, Massachusetts Institute of Technology, on Monday morning, December 27. Addresses of welcome were given by President McLaurin, of the Institute of Technology, and by Dean W. C. Sabine, of the Graduate Scientific School of Harvard, representing the president of Harvard University. On Monday night the address of the retiring president, Prof. T. C. Chamberlin, of the University of Chicago, was delivered in Sanders Theatre, Harvard University. His subject was a geologic forecast of the future opportunities of our race. The address was preceded by an address of welcome at Harvard University by Prof. F. W. Putnam, a past-president of the association, and who, from 1873 to 1898, was its permanent secretary. After the address a reception was held by the corporation of Harvard University in Memorial Hall. During the week the addresses of the vice-presidents (or chairmen) of the sections were given on the different afternoons as follows:—

Vice-President Keyser, before the Section of Mathematics and Astronomy, the thesis of modern logistic; Vice-President Guthe, before the Section of Physics, some reforms needed in the teaching of physics; Vice-President Kahlenberg, before the Section of Chemistry, the past and future of the study of solutions; Vice-President Swain, before the Section of Mechanical Science and Engineering, the profession of engineering and its relation to the American Association for the Advancement of Science; Vice-President Willis, before the Section of Geology and Geography, the principles of paleogeography; Vice-President Herrick, before the Section of Zoology, evolution of intelligence and its organs; Vice-President Richards, before the Section of Botany, the nature of response to chemical stimulation; Vice-President Woodworth, before the Section of Anthropology and Psychology, racial differences in mental traits; Vice-President Holt, before the Section of Social and Economic Science, the gold question; Vice-President Howell, before the Section of Physiology and Experimental Medicine, chemical regulation in the animal body by means of activators, kinases, and hormones; Vice-President Dewey, before the Section of Education, science as a method of thinking and science as information in education.

The meeting was marked by a series of joint meetings between sections of the association and corresponding affiliated societies. By virtue of a resolution adopted by the council at its April meeting, sectional committees arranged in almost every case one or more sessions of general interest, conducted under the auspices of the sectional officers, while programmes of papers of a strictly technical character and of interest limited to specialists were read under the auspices of the affiliated societies. This arrangement was particularly happy in the cases of Section A and the American Mathematical Society; Section B and the American Physical Society; Section C and the American Chemical Society; Section E and the Geological Society of America; Section F and the American Society of Zoologists; Section G and the Botanical Society of America; and Section H and the American Anthropological Association. Under Section K an important symposium on the subject of internal secretion was held, at which the following papers were presented:—A general review of the chemical aspect of internal secretion, by R. H. Chittenden; the internal secretion of the pancreas, by W. G. McCallum; our present knowledge of the thyroid function, by S. P. Beebe; metabolism after parathyroidectomy, by J. V. Cook; and physiological consequences of total and of partial hypophysectomy, by H. Cushing.

On Tuesday evening, December 28, a public lecture complimentary to the citizens of Boston was given by Dr. C. W. Stiles, of the United States Public Health and Marine Hospital Service, on the subject of the hookworm problem in the United States in reference to public health. This lecture, the subject of which is brought prominently into the public eye at this time on account of Mr. Rockefeller's gift of 1,000,000 dollars to be devoted to an effort to stamp out the hookworm in the south, was attended by a large audience.

On Thursday evening, December 30, an interesting lecture was given by Dr. John B. Smith, on the subject of insects and entomologists, their relation to the community at large.

On Wednesday evening, December 29, the Society of American Naturalists and the biologists in attendance at the meeting held their annual dinner, at which the address of the retiring president of the naturalists, Prof. T. H. Morgan, was given. His subject was "Chance or Purpose in the Evolution of Adaptation." The American Chemical Society gave its annual dinner on the Thursday evening. Other dinners of special organisations were scattered through the week.

At the meeting of the general committee, Minneapolis was chosen as the place of the next meeting, beginning December 27, 1910. The following officers were elected:—

President:—Prof. A. A. Michelson, University of Chicago. Vice-Presidents (or presidents of sections):—Section A, Prof. E. H. Moore, University of Chicago; Section B, Dr. E. B. Rosa, Bureau of Standards, Washington; Section C, Prof. G. B. Frankforter, University of Minnesota; Section D, Prof. A. L. Rotch, Blue Hill Observatory, Boston, Mass.; Section E, Dr. J. M. Clarke, State Geologist, Albany, N.Y.; Section F, Prof. J. Reighard, University of Michigan; Section G, Prof. R. A. Harper, University of Wisconsin; Section H, Prof. R. B. Dixon, Harvard University; Section I, Dr. T. E. Burton, Cleveland, Ohio; Section K, Prof. F. G. Novy, University of Michigan; Section L, the Hon. A. Ross Hill, president, University of Missouri. Secretary, Section I., Fred C. Croxton, Washington, D.C.; permanent secretary, Dr. L. O. Howard, Smithsonian Institution, Washington, D.C.; general secretary, Prof. F. E. Clements, University of Minnesota; secretary of the council, Prof. J. Zeleny, University of Minnesota.

Grants were made to the Concilium Bibliographicum Zoologicum at Zürich, and to individuals as follows:—To Prof. T. D. A. Cockerell, to assist in an investigation of the microscopic structure of the scales of different genera of fishes; to Dr. W. D. Hoyt, to assist in an investigation upon environic relations of the alga Dictyota, which develops a rhythm in fruiting coincident with every alternate springtide; to Prof. G. J. Peirce, to assist in investigations of organisms inhabiting the alternately filling and drying salt-water pools along the coasts of central California. The last two grants are to be expended under the supervision of the standing committee upon the relation of plants to climate.

THE MEAN HEIGHT OF THE ANTARCTIC CONTINENT.

PROF. W. MEINARDUS gives the results of an estimate of the mean elevation of the central core of the Antarctic land mass, based on the distribution of atmospheric pressure and consequent exchange of air between the two hemispheres, in the November and December numbers of Petermann's *Mitteilungen*. Extending Spitaler's results with the help of Mohn's discussion of the *Fram* observations, and Baschin's maps of the southern oceans, Prof. Meinardus finds that, while the mean pressure (not reduced to sea-level) is 0·85 mm. higher in January than in July between latitudes 0° to 80° N., in the zone 0° to 50° S. it is 2·14 mm. lower. In higher southern latitudes, as far as 60° S. lat., the January pressure is 0·73 mm. less than the July, and from 60° S. to the Antarctic circle the relation is almost one of equality. Hence, allowing for proportional areas, it follows that within the Antarctic circle the true atmospheric pressure must be 11 mm. higher in January than in July.

Observation, however, has so far failed to reveal the existence of this excess; the diminution of the southward temperature gradient and consequent weakening of easterly winds on the edge of Antarctis in summer render it probable that, as in the north polar region, the pressure at sea-level is actually lower in summer than in winter. The discrepancy can be explained by assuming a mean elevation for the area within the Antarctic circle, and taking −3° and −26° as the mean temperatures for January and July respectively, Porf. Meinardus gets a value for this of 1328 metres, or, as a second approximation with temperatures −6° and −29°, 1350 metres, with a probable error of ± 150 metres. Having regard to the proportion of the area known to be covered by sea, the land surface is taken as 14 millions of square kilometres (Bruce and Krümmel), and its mean height then becomes 2000 metres, with a probable error of ±200 metres.

Recent explorations suggest that this value is not far from the truth, the covering of inland ice being, as in Greenland, an important factor. If it is approximately correct, Antarctica is the largest mass of raised land in the world; it is half as large again as Europe, and Asia, the highest of the known continents, has a mean elevation of less than half (950 metres). The accepted value of the mean height of the land surface of the world, 700 metres, is raised to 825 metres, and the mean level of the physical surface of the globe from 205 to 240 metres.

THE NATURAL HISTORY MUSEUM.

IN NATURE of December 16 and 30 we reprinted from the *Times* some letters dealing with this subject. We were under the impression that the main point of contention was the complete separation of the Natural History Museum from the other collections in the British Museum, as recommended by the Duke of Devonshire's Royal Commission in 1874, to go no further back.

Sir Archibald Geikie has since pointed out to us that the questions put to him in the letter from the Speaker of the House of Commons to which he replied "were entirely in reference to the relations between the Trustees and the Museum," and that, this being so, we should have given a letter from Mr. Carruthers dealing with this point which had also appeared in the *Times*. We therefore now reprint the letter in question:—

Sir,—The President of the Royal Society, Sir Archibald Geikie, has expressed clearly his view on the questions in relation to the administration of the British Museum recently raised in your columns. A former eminent President, Prof. Huxley, was brought by his experience as Trustee, as Sir Archibald has been, to similar favourable conclusions.

It was notorious that Prof. Huxley severely criticised the governing body of the Natural History Departments of the British Museum. He had expressed this view to me personally, but, after he had been some time a Trustee, he spontaneously informed me that he had totally changed his opinion, and that he could not imagine a more efficient system of administration. This, I must add, was previous to 1898.

As Keeper of Botany for twenty-four years, I cannot recall a single occasion in which my department suffered from the action of the Trustees. I always found them intelligent and sympathetic in the affairs of the department.

William Carruthers.

NOTES.

The council of the Royal Astronomical Society has awarded the gold medal of the society to Prof. F. Küstner, director of the University Observatory of Bonn, for his catalogue of stars, his pioneer determination of the aberration constant from motions in the line of sight, and his detection of the variation of latitude.

The Geological Society of London will this year award its medals and funds as follows:—Wollaston medal, to Prof. W. B. Scott; Murchison medal, to Prof. A. P. Coleman; Lyell medal, to Dr. A. Vaughan; Wollaston fund, to Mr. E. B. Bailey; Murchison fund, to Mr. J. W. Stather; Lyell fund, to Mr. F. R. Cowper Reed and Dr. R. Broom.

Prof. R. Meldola, F.R.S., has been elected an honorary member of the Sociedad Española de Fisica y Quimica.

Prof. W. Trabert has been appointed director of the k.k. Zentralanstalt für Meteorologie und Geodynamik at Vienna.

M. G. Eiffel has been elected president of the Meteorological Society of France for 1910, and M. Teisserenc de Bort and Dr. de Valcourt vice-presidents.

The death is announced, at the age of ninety-one years, of Dr. George Skene Keith, formerly a well-known Edinburgh physician. Dr. Keith was the author of the book "Plea for a Simpler Life," which had a wide circulation, and of other works.

By the will of the late Sir Alfred Jones, the sum of about 500,000*l*. will be at the disposal of the trustees "for such charitable purposes and objects in England (or any British possession on the west coast of Africa) as they may in their absolute discretion think fit." For the guidance of the trustees in the administration of this very comprehensive trust, Sir Alfred Jones made the following suggestions, among others, as to purposes to which it might be applied:—(*a*) the technical education of natives on the west coast of Africa; (*b*) the advancement, benefit, or support of education or science; (*c*) original research of all kinds into the cause of disease on the west coast of Africa.

Sir Ernest Shackleton has denied the rumour, to which reference was made in a note last week, that he is to lead this year a third expedition to the Antarctic. He discussed Antarctic exploration recently with a private party of geographical experts in Berlin, and on that occasion explained that, in the event of his going south again, he would travel polewards from the Weddell Sea or Gaussberg. The Weddell Sea was penetrated to 74° 15′ S. by Captain Weddell in 1823. The Gaussberg is a basalt mountain in Kaiser Wilhelm's Land, on the southern shore of the bay in which the *Gauss*, the vessel of the German Antarctic Expedition of 1901–3, reached its farthest south. Captain Scott proposes to establish his base near MacMurdo Sound, which was the winter quarters of the *Discovery*, and near which Sir Ernest Shackleton had his main base during the late expedition.

We learn from a note in the *Engineer* for January 7 that dirigible airship companies are moving fast in Germany. A Parseval airship was ordered this month by the Munich Aëronautical Company, the share capital of which is to be increased to 400,000 marks. The airship is expected to be delivered on May 1, when regular aërial tours are to be commenced. An airship station is to be built in the Upper Bavarian tourists' territory, to which flights will be made from Munich. Another aëronautical company has been founded this month for exploiting the motor-driven airships according to the system of Herr Zorn, and for establishing airship lines. The municipality of Gräfrath has placed about sixty-eight acres of ground at the disposal of this company. Major Von Parseval has accepted a nomination as unsalaried lecturer on dirigible airships at the Charlottenburg High School, and has already given one lecture before the teaching staff.

The next International Congress of Mining, Metallurgy, Applied Mechanics, and Practical Geology will be held at Düsseldorf in the last week of June next. The conference will be divided into four sections, dealing respectively with the subjects named in the title of the congress. The president of the mining section is Mr. Randebrock, director-general of the Gelsenkirchener Mining Company; of the metallurgical section, Mr. Springorum, director-general of the Hoesch Iron and Steel Works; of the applied mechanics section, Mr. C. Kiesselbach; and of the practical geology section, Mr. Schulz-Briesen. The general secretaries are Dr. Schrödter and Mr. Loewenstein. There will be two grades of membership of the congress: members, who are entitled to become patrons of the congress by payment of not less than 5*l*., and members who pay a subscription of 1*l*. Any inquiries should be addressed to the committee of organisation of the congress, Jacobistrasse 3/5, Düsseldorf, Germany. Members of the Iron and Steel Institute resident in the United Kingdom who wish to attend the congress are requested to apply to the institute not later than February 26.

During last week the Liverpool Geological Society celebrated the jubilee of its first meeting. On Monday, January 10, the society entertained at dinner the Lord Mayor and Lady Mayoress, and representatives of the University, of kindred societies in the city, and of the Yorkshire Geological Society and the North Staffordshire Field Club. The toast of the University elicited expressions of regret at the absence of a chair of geology in the University. The first meeting of the society having been held on January 11, 1860, an open meeting was held on the Tuesday of last week, and was largely attended. Mr. W. Hewitt, the president, was in the chair, and the minutes of the first meeting having been read, he remarked that that meeting was held in a room in the house of Mr. G. H. Morton, the first honorary secretary of the society. He also read a letter from Mr. H. Duckworth, the first president, congratulating the society and regretting that his age prevented his being present. Prof. J. W. Judd, C.B., F.R.S., an honorary member of the society, then delivered an address on "The Triumph of Evolution: a Retrospect of Fifty Years," remarking that the foundation of the society was nearly coincident with the appearance of Darwin's "Origin of Species." A very careful *résumé* of the address appeared in the Liverpool papers, and it is to be hoped that the address will later be printed *in extenso*.

The first and second annual reports presented by the council of the National Museum of Wales to the Court of Governors are now available. The second report deals with the year ending September 30 last, and records satisfactory progress in the work of founding and establishing the museum. The report points out that Dr. W. E. Hoyle, the director of the museum, entered upon his official duties on March 1. In August an advertisement was issued requesting designs to be sent in for a building to cost 250,000*l*. when complete, and it is hoped it may be found possible to erect about one-third of it in the first instance. The sum of 2000*l*. is included in the estimates of the Chancellor of the Exchequer for the current financial year to defray the working expenses of the museum, and of this 500*l*. has been received. The trustees of the "Cardiff Fund" have handed over the sum of 26,796*l*. which had been collected as a contribution to the building fund in the event of the museum being located in Cardiff. A Bill, promoted by the Cardiff Corporation, is before Parliament empowering the Corporation to make over to the National Museum the collections contained in the Welsh Museum of Natural History, Arts and Antiquities, belonging to the municipality, together with the proceeds of a halfpenny rate, which at the present time would yield about 2000*l*. per annum, towards the maintenance of the museum. In March last the director of the museum visited northern Germany and Scandinavia to study museums and kindred institutions with the view of acquiring information which will be needed in organising the new institution, and a report on the visit is printed as an addendum.

The *Journal of Conchology* for January contains a paper, by Mr. J. W. Vaughan, on the land and fresh-water molluscs of South Wales.

The *Entomologist's Monthly Magazine* for January opens with a coloured plate of seven rare or otherwise interesting British insects, of which one is a wasp, while the remaining six are beetles. The wasp, *Odynerus herricki*, was first recorded as British on the evidence of a single specimen in Dorsetshire in 1878; a second example was subsequently taken in Purbeck, and a third near Wareham, but in 1908 the species was found in abundance near Swanage.

In the report of the Madras Government Museum for 1908–9 it is announced that, at the time when the document was drafted, four volumes of Mr. Edgar Thurston's encyclopædic work on the "Castes and Tribes of Southern India" were then ready, and that it was hoped the printing of the remaining volumes would be completed during the current financial year. The museum has received a number of additions during the year, among which may be mentioned a series of coins acquired by means of the Indian Treasure Trove Act.

The value of the stereoscope in biological investigations forms the subject of an article, by Dr. W. Berndt, in *Naturwissenschaftliche Wochenschrift* of January 2. The instrument, it appears, has lately been used by Prof. F. E. Schulze, of the Berlin Zoological Institute, for the investigation of the structure and mode of action of the ultimate ramifications of the bronchial tubes, or broncheoli, in the lungs of mammals. Such objects have to be prepared in a special manner before being photographed for the stereoscope, but when this is done a stereogram is stated to afford an insight into the structure which cannot be obtained in any other way. Stereograms of an amœba, of the broncheoli of a rat's lung, and of a section of the lung of an ostrich illustrate the paper.

We are indebted to the author, Mr. J. W. Shoebotham, for a copy of his paper on the life-history of *Callidium violaceum*, reprinted from vol. iv., part iv., of the *Journal of Economic Biology*. In the year 1908 Mr. Shoebotham noticed insect-borings in some of the wooden fences near Berkhamsted, and subsequently ascertained that these were made by the larvæ of the beetle *Callidium violaceum*, a species which does not appear to have been observed in England as damaging timber since the time of the Rev. William Kirby. Mr. Shoebotham has worked out the life-history of this beetle, which attacks only coniferous timber —more especially larch—from which the bark has not been removed. The larvæ burrow between the bark and the wood, but subsequently tunnel into the latter, in which they pass the pupa-stage.

In the January number of Witherby's *British Birds* further notes are given with regard to the flights of crossbills which visited the British Islands in the second half of 1909. In Durham these birds were noticed in the last week of June, while at Woburn Abbey a flock was observed so late as December 24. As an appendix to these notes, Dr. C. B. Ticehurst refers to the circumstance that the crossing of the two halves of the beak in these birds is dimorphic, the upper half having its tip directed in some cases to the right and in others to the left side. In *Loxia curvirostra* the rights seem to be about equal in number to the lefts, but in *L. leucoptera* the lefts appear to be twice as numerous as the rights. Further specimens are, however, required before the existence of such a difference between the two species can be considered proven. In 1903 three examples of the black-winged pratincole (*Glareola melanoptera*) were shot in Kent, these being the first recorded British examples of the species. A fourth specimen was shot at Northallerton, Yorkshire, on August 17, 1909.

A description of the lateral roots of *Amyelon radicans*, a Carboniferous type now accepted as part of a gymnospermous Cordaitean structure, forms the subject of a paper, by Mr. T. G. B. Osborn, in the *Annals of Botany* (vol. xxiii., No. 92) with respect to the branching of the root and the occurrence of a fungus permeating the cells of the cortex. The fungus mycelium is traceable in the outer cortex, but only forms dense tufts in the inner zone; the hyphæ are non-septate, ending sometimes in thick-walled vesicles. Proceeding from analogy with the root-tubercles of Podocarpus, and having regard to the branching tendency of the lateral roots, the author arrives at the conclusion that the fungus was a mycorrhiza.

The Government of India has issued two additional Forest Pamphlets (Nos. 10 and 11) dealing with Indian timbers, prepared by Mr. R. S. Troup, the Imperial forest economist. The first refers to *Lagerstroemia tomentosa*, a tree, yielding Burmese Leza wood, that grows in the forests of Burma with *Xylia dolabriformis*. It might be classed with American birch, with which, however, it could not compete on the European market. It is recommended for use in India for tea-boxes, and is under trial for railway sleepers, as also for conversion into match splints. The second pamphlet deals with *Carallia integerrima*, which yields a timber resembling European oak in the silver grain, but differing in its brittle nature. Locally it is used in construction and for agricultural implements, and has been favourably reported on for brush-backs.

A paper on the British pansies, contributed by Dr. E. Drabble to the Journal of the Royal Horticultural Society (vol. xxxv., part ii.), is brought to notice, not only for the observations which are recorded, but also because it represents a line of work which is desirable and likely to be fruitful in results, especially in the case of plants which are hybridised. The author has taken the species *Viola tricolor*, L., and traced out by comparison with authentic specimens, as also by growing plants through several generations, a series of forms—the elementary species of Jordan and Boreau—among British plants. As a conclusion, four classes of British pansies are demarcated, and it is suggested that the garden stock may have been produced from *Viola Lloydii*, *V. variata*, and (rather doubtfully) *V. polychroma* by crossing with *V. lutea*.

When consideration is given to the great difference between the conditions in the Alps and in English gardens, it is a matter for surprise that so many Alpine plants can be grown successfully in our climate. The contrast is well brought out in an article published in the Journal of the Royal Horticultural Society (vol. xxxv., part ii.) by Mr. A. Clutton-Brock, who submits some arguments with respect to cultivation and treatment which cannot fail to interest the growers of alpines. Primarily, the author directs attention to the correct disposition of rocks and stones so that the roots may run underneath and obtain protection from drought. This is particularly necessary for Dryas, *Silene acaulis*, and *Polygala Chamaebaxas*. Top-dressing is suggested for Primula and *Aster alpinus* to imitate the action of deposits left by the snow. Close planting is another recommendation, provided unequal competition between intermingling plants can be avoided. On this point the author gives details regarding suitable combinations of plants.

From the *Agricultural Journal of British East Africa* we learn that cotton growing is making steady and continuous progress at the coast, although the early difficulties were very numerous, and large sums of money had to be expended in educational work. There is still the prospect of trouble with insect pests, but it is stated that cotton growing is distinctly profitable to the native. In the same journal there is also a suggestive article on the prospects of the production of cane sugar; considerable quantities are at present imported, but there is every reason to believe that it could be produced locally and form the basis of a flourishing industry.

We have received from the United States Department of Agriculture Bureau of Soils a bulletin, by Dr. Whitney, summarising the results of nearly 3000 manurial trials on cotton soils made during the past twenty-one years. The general conclusion is that complete fertilisers give the largest and, as a rule, the most profitable crop. The increase in yield due to mixtures of artificial manures was approximately an additive effect, an interesting result that deserves further examination. A report is also issued on the Volusia soils, which cover an area of more than ten million acres in southern New York, northern Pennsylvania, and north-eastern Ohio, and are commonly said to be "worn out," the farms in some localities having been abandoned. It is well illustrated and typical of the soil survey work carried out by the department. The soils suffer from lack of drainage, poor physical condition, and depletion of organic matter, conditions for which suitable remedies are suggested.

We have received advance chapters of the annual report on the mineral production of Canada during the calendar years 1907 and 1908, dealing respectively with the production of coal, coke and peat, of natural gas and petroleum, and of iron and steel in the Dominion. These reports show a steady but not a great development in all these branches of mineral industry; the production of coal in the two years in question was respectively 10,511,426 and 10,886,311 tons, as against 9,762,601 tons in 1906, about one-eighth of this being made into coke; the production of peat was practically nil. The production of crude petroleum was 788,872 barrels (of 35 gallons) in 1907 and 527,987 barrels in 1908; the production of natural gas was also important. The production of pig iron is about stationary, being 651,962 tons in 1907 and 630,835 tons in 1908, about one-sixth in each case being smelted from native and the remainder from imported ores.

Mr. R. A. Stewart Macalister, by permission of the committee of the Palestine Exploration Fund, for whom the materials were originally collected, contributes to the number of the Journal of the Gypsy-lore Society for October, 1909, the first of a series of papers on the language of the Nawar or Zutt, the nomad smiths of Palestine. The language is in its basis pure Romani, but it has assimilated many Arabic words, that is to say, not literary Arabic, but the colloquial dialect of Palestine. Some words are used without change, but a large number have become naturalised in Nuri, either indicating that they are survivals of a period when the tribe had newly arrived in Arabic-speaking lands, or that some terms have been modified with the object of secrecy to adapt them for use in the tribal argot. Mr. Macalister works out carefully the method of making these modifications. It is to be regretted that few of the stories so far published include any interesting or characteristic folk-lore material, most of the examples being incidents of everyday life or scraps of folk-tales dictated by the compiler.

An excellent general account, by Dr. H. R. Mill, of the rainfall of the British Isles in 1909, in relation to other years, is contained in the *Times* of January 14, based upon a preliminary study of some 2000 of the returns of the British Rainfall Organisation, and on a comparison of 100 long-established records, distributed as uniformly as possible over the country, with their own averages for 1870–99. These latter values are given in tabular form, and the summary of the percentages shows considerable differences in various divisions; in Scotland, as a whole, the annual rainfall was practically normal; in Ireland and Wales there was a deficiency of 5 per cent., in the north of England a considerable excess, while the amount over the British Isles generally was exactly the average. These results naturally agree in the main with those given by the Meteorological Office in its annual summary (Nature, January 6). The best idea of the difference of the annual rainfall of the year from the average is shown by a neat little map. This exhibits conspicuous dry areas in the extreme south-west of Ireland, Wales, and England, and in the north-west of Scotland. The distinctly wet regions, with more than 10 per cent. above the average, surround the south and east of Great Britain; another area with more than 10 per cent. was in Lincoln, the north-east of Yorkshire, and Lancashire. The wettest months, generally speaking, were March, April, October, and December. November was unquestionably the driest month; over the whole of England the rainfall was only one-third of the normal. Dr. Mill remarks that the year probably acquired its undeserved reputation for wetness from the chilly gloom of some of the summer months, which both looked and felt far wetter than they were.

Messrs. Teubner are issuing in pamphlet form some of the most important of the public addresses which have been delivered by distinguished German physicists during the last few years. Amongst them is one on electrons, given by Prof. W. Wien before the Versammlung deutscher Naturforscher, which has already reached a second edition. It deals in a clear and interesting way with the rise and progress of our knowledge of the properties of electrons, and explains the methods by means of which that knowledge has been acquired, without making a great demand on the reader's mathematical powers. Prof. Wien prefers the theory which makes an electron in motion take a spheroidal shape to that on which electrons are rigid spheres, and shows in his additions to the present edition that the evidence from the principle of relativity supports this view. A special difficulty of the electron theory is, in his opinion, that of explaining how an electron holds together under the enormous repulsive forces which the parts of it exert on each other.

The *Journal de Physique* for December, 1909, contains a paper communicated to the Société française de Physique on November 19 by M. L. Houllevigue, in which the sizes of the particles shot off from a silver kathode in a vacuum tube are calculated. The method depends on the fact that when a vapour condenses on a surface colder than itself the drops form at definite points of the surface constant in number, and if evaporated and re-condensed form again at the same points. When a glass surface has been exposed to bombardment from the kathode rays, the author considers that the points at which condensation of a vapour occurs are those at which particles of the kathode have become attached to the glass. The number of these points, and therefore of the kathode particles, is proportional to the time of exposure to the bombardment, and may be counted directly under the microscope after mercury vapour has condensed on them. The thickness of a deposit may then be found by Fizeau's method after the film has been exposed to the vapour of iodine. From the volume of the deposit on any area and the number of particles calculated from the counting experiment, M. Houllevigue finds the volume of the particle shot off from a silver kathode to be about 7×10^{-13} cubic millimetres, that is, it consists of about 20 million molecules.

For several years the Scottish Provident Institution, Edinburgh, has issued, within the covers of a blotter, an excellent set of star-maps, by Mr. W. B. Blaikie, showing the constellations visible when facing north and south month by month. The stars are represented by gilt asterisks on a dark blue background, upon which the names of the constellations are printed in black, so that when the charts are viewed at a suitable angle the stars are seen without the names, the result being very effective. With the 1910 issue (the thirteenth series), a chart of the heavens in two hemispheres is included showing the track of Halley's comet in 1909–10, and some notes upon the comet's orbit and spectacular appearance. The usual particulars of the positions of the sun, moon, and planets throughout the year are also given. The publication is excellently produced, and should continue its usefulness in promoting an intelligent interest in the aspects of the heavens and the movements of celestial bodies.

A VALUABLE paper on the testing of impulse water-wheels of the Pelton wheel type was presented by Mr. William Rankine Eckart at the Institution of Mechanical Engineers on January 7. This paper is of interest on account of the experiments described being the first of the kind on such a large scale. By means of the Pitot tube and other measuring devices the author has measured the nozzle discharge under different conditions, and so has determined the hydraulic efficiency of the generating plant, the capacity of each water-wheel amounting to about 3500 horse-power. The following table gives a summary of the more important results of the four tests made, and shows the distribution of the power as percentages of the power in the jet:—

Test number	1	2	3	4
Loss in bucket friction and eddies ...	23·0	23·2	27·7	29·2
Loss in residual velocity of discharge..	1·1	1·0	1·8	1·9
Other hydraulic losses	1·5	1·6	1·1	0·8
Loss in friction and windage, generator and wheels	7·5	4·4	3·2	2·8
Loss in generator, iron and armature..	2·8	1·8	1·3	1·2
Delivered to switchboard	64·1	68·0	64·9	64·1

IN the discussion on the hydraulic papers at the Institution of Mechanical Engineers on January 7, Dr. Unwin referred to the difficulties which Canadian engineers have to contend with in preventing stoppages from ice. Block ice is easily dealt with. With frazil ice, *i.e.* minute particles of ice suspended in and moving with the water, the difficulty is serious. We learn from a recent number of the *Canadian Engineer* that about forty water-wheels at and near Ottawa are now equipped with heating devices, which prevent frazil from stopping the wheels and clogging the gates and gate-mechanisms. The latest 3000-horse-power unit at the Ottawa and Hull Power and Manufacturing Company's Station has the chutes and gate chambers cored out, and there are pipe connections to the openings so that steam or hot water may be kept circulating through them when frazil is anticipated. The racks or screens are kept free from ice by electric motor-driven rakes, and at present none of these is heated. Mr. John Murphy recommends that the racks be submerged or otherwise protected from the atmosphere, when only a small amount of heat would be necessary to prevent ice clinging to them.

COMMENTING on the evidence offered at the inquiry into the cause of the disastrous fire at Messrs. Arding and Hobbs, Clapham Junction, the *Builder* for January 8 finds itself unable to agree with the architect's—Mr. Thorneycroft—opinions regarding his belief in the merits of steel as a structural material. Evidently he does not consider reinforced concrete to be a practical substitute for steel. It is, of course, understood that there are difficulties in altering and enlarging old buildings which prevent the changing of the general nature of the construction. Other evidence showed that, had there been concrete floors, and if the steel-work had been encased in concrete, there would have been little to burn except the contents of the rooms. As it was, the girders were only protected by the matched lining, and the distortion of the steel brought the building down. However strongly one may disapprove such methods of construction, the fact remains that the Clapham Junction building conformed with the requirements of the law, and represented quite an ordinary risk. Under the new regulations of the County Council protected steel-frame or reinforced concrete buildings ought to cost no more than structures of brick and unprotected steel. The extreme undesirability of the latter type is the most important lesson of this fire.

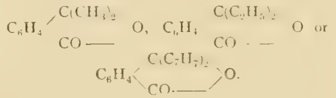
ON account of its fundamental importance in atomic-weight determinations, numerous researches have been published during the last four years on the atomic weight of chlorine, in most of which the direct ratio H/Cl has been attempted by gas volumetric or gas density methods. The latest contribution to this subject is by Otto Scheuer, who, in the current number of the *Zeitschrift für physikalische Chemie*, finds the weight of a litre of hydrochloric acid to be 1·6394 under normal conditions. From this the figure 35·466 is deduced as the atomic weight of chlorine, differing from the 35·460 of Gray and Burt by about 1 part in 6000. The paper in the *Zeitschrift* gives full details of the experimental work, and also of the methods of reduction employed. A critical examination of the results of Gray and Burt is given at the end of the paper.

THE place of honour in the *Bulletin de la Société d'Encouragement pour l'Industrie nationale* for November, 1909, is given to a study, by MM. Pipereaut and Vila, on the manufacture of zinc sulphide and its use as a pigment. From a report by M. A. Livache, which precedes the memoir, it appears that a law has just been passed prohibiting entirely the use of white lead as a paint after the expiry of a period of five years, and that the authors have devised a satisfactory method of preparing zinc sulphide, as a substitute, by dissolving the oxide in caustic alkali and boiling the solution with sulphur, the first portion of which throws down the impurities (lead and other metals giving coloured sulphides), whilst the later additions precipitate the zinc sulphide in a pure form which (after drying at a red heat) is eminently suited for use as a paint.

THE monographs on photo-chemistry by Prof. Bancroft, which have been appearing in recent numbers of the *Journal of Physical Chemistry*, have been followed up by two experimental papers, one of which, by Mr. G. A. Perley, on solarisation, appears in the November number, and the other, by Mr. J. W. Wilkinson, on the phosphorescence of some inorganic salts, in the December number of 1909. The latter contains an interesting account of some luminous effects produced during the electrolytic preparation of insoluble metallic salts, and during slow oxidation, chlorination, &c. In a large range of cases it is shown that the colour of the light emitted is identical with that which is produced when the salt is made to phosphoresce by various methods, and the view is advanced that the phosphorescence is due to certain definite types of chemical change.

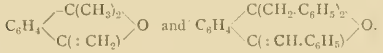
The *Journal of Physical Chemistry* for November, 1909, contains a paper, by Mr. B. E. Curry, on the alloys of zinc with antimony, tin, cadmium, bismuth, and lead. Although the metal forms two layers with lead and with bismuth at low temperatures, the mutual solubility increases rapidly as the temperature is raised, the lead-zinc alloys becoming completely homogeneous at about 920° and the bismuth-zinc alloys at 820°. The formation of compounds was observed only in the alloys of zinc and antimony, which gave crystals of $ZnSb$ and Zn_3Sb_2, but solid solutions were obtained of zinc in tin (up to 7 per cent. Zn), in bismuth (up to 4 per cent. Zn), and in cadmium (up to 4 per cent. Zn), and of cadmium in zinc (up to 4 per cent. Cd); the zinc-antimony alloys also gave three series of solid solutions, resulting in a very complex equilibrium diagram.

The Journal of the College of Science, Tokyo, of June 15, 1909, which has recently come to hand, contains a paper, by Y. Shibata, on the action of the Grignard reagent on *o*-phthalic esters. The *p*-phthalic esters have been shown by Ullmann and Schaepfer to resemble the succinic esters in giving glycols of the type $C_6H_4\left<\begin{matrix}CR_2.OH\\CR_2.OH\end{matrix}\right.$, but the main product from the *o*-esters is a phthalide such as



$$C_6H_4\left<\begin{matrix}C(CH_3)_2\\CO\text{——}\end{matrix}\right>O,\quad C_6H_4\left<\begin{matrix}C(C_2H_5)_2\\CO\text{——}\end{matrix}\right>O \text{ or } C_6H_4\left<\begin{matrix}C(C_7H_7)_2\\CO.\text{——}\end{matrix}\right>O.$$

The action may, however, proceed further, giving rise to the compounds



$$C_6H_4\left<\begin{matrix}C(CH_3)_2\\C(:CH_2)\end{matrix}\right>O \text{ and } C_6H_4\left<\begin{matrix}C(CH_2.C_6H_5)_2\\C(:CH.C_6H_5)\end{matrix}\right>O.$$

A remarkable compound of the second group is obtained by the action of phenyl magnesium bromide. It is formulated as $C_6H_4\left<\begin{matrix}C(C_6H_5)_2\\C(:C_6H_4)\end{matrix}\right>O$, but must be regarded as containing a trimethylene or "carone" ring in the group $=C\;C_6H_4$.

Mr. P. D. Malloch, of Perth, is publishing through Messrs. A. and C. Black a book on the "Life-history and Habits of the Salmon, Sea-trout, Trout, and other Freshwater Fish." From his connection with the Tay Salmon Fisheries Co., the author has had unusual opportunities of studying the subject, and has been able to clear up many doubtful points by the marking of smolts and their recapture as grilse and salmon. The study of scales also forms a section of the book.

M. Ch. Delagrave, of Paris, has sent us a copy of "La Langue Internationale et la Science," which is published at the price of one franc. This volume is a French translation of a book reviewed in these columns on August 19 last (vol. lxxxi., p. 218), "Weltsprache und Wissenschaft. Gedanken über die Einführung der internationalen Hilfsprache in die Wissenschaft," by Profs. L. Couturat, O. Jespersen, R. Lorenz, W. Ostwald, and L. Pfaundler. The translation has been done by M. Boubier, of the University of Geneva.

The issue of Willing's "Press Guide and Advertiser's Directory and Handbook" for 1910 (price 1*s.*) has reached us. It continues to be what its subtitle claims for it—a concise and comprehensive index to the Press of the United Kingdom. It provides information concerning all the newspapers, magazines, reviews, and other periodicals, including journals, proceedings, reports, and transactions of learned societies. Lists of the principal colonial and foreign journals are also included.

The 1910 issue of "The Science Year Book," edited by Major B. F. S. Baden-Powell, and published by Messrs. King, Sell and Olding, Ltd., at 5*s.* net, includes several new features. The volume contains a monthly astronomical ephemeris which should be of particular service to astronomers and other observers, many useful tables, star-maps for the four seasons, with key-charts showing the names of constellations visible, a brief summary of matters of scientific interest in 1909, a glossary of recently introduced scientific names and terms, a full list of learned societies with particulars of membership, and a short account of various prizes and awards for scientific research. A good portrait of Sir Archibald Geikie, K.C.B., forms a frontispiece to the volume, and there is a chart showing the track of Halley's comet during 1910. The remainder of the volume consists chiefly of a diary, with a page for each day, and having at the head columns for the insertion of maximum and minimum temperatures, barometric height, rainfall, and other results of meteorological observation. The volume provides observers with exactly the kind of tabular information frequently required; and, with the diary, it constitutes a year-book which merits a place upon the study tables of many men of science and the bookshelves of observatories.

OUR ASTRONOMICAL COLUMN.

Discovery of a New Comet.—Telegrams from the Kiel Centralstelle announce the discovery of a new comet at Johannesburg on January 17. In the first it was stated that the comet was discovered by Mr. Drake, and was seen at and after sunrise. Its approximate position was given as five or ten degrees south-south-west of the sun, which it was approaching.

The second telegram gives the more exact position, at 21h. 21·5 m. January 16 (Johannesburg M.T.), as

R.A. 19h. 50m. 28s., $\delta = 25^\circ\ 0'$ S.,

and states that the daily motion is +16m. 32s. in R.A. and $-2^\circ\ 25'$ in N.P.D.

As this object is intensely bright as it was seen in sunshine, and is travelling northwards, we may expect a fine display after sunset during the present week.

Halley's Comet.—A telegram from Messrs. Frost and Parkhurst, dated December 31, 1909, and published in No. 4381 of the *Astronomische Nachrichten*, states that the prismatic camera shows the light of Halley's comet to be now largely due to the third cyanogen band. This suggests that attempts to photograph the comet should now be made with quartz objectives or speculum reflectors. Both glass objectives and silver-on-glass mirrors absorb a large percentage of the ultra-violet radiations, and the difficulty of obtaining quartz lenses of large aperture may possibly be compensated for by the much greater transparency of quartz, as compared with glass, to the more refrangible rays.

The anomalous apparent brightening of the comet which occurred in November has not been continued, and until about the middle of March the distance between the comet and the earth will continuously increase; but it is thought that the development of the comet, as it approaches nearer to the sun, should be sufficient to make naked-eye observations possible by about the end of February.

This anomalous increase of the apparent brightness is described by the Rev. T. E. R. Phillips in a note appearing in No. 2, vol. lxx., of the Monthly Notices. He commenced observing, with a 12¼-inch Calver reflector, on November 16, and observed the apparent brightness on ten nights between that date and December 8; from these observations he concludes that the apparent brightness of the comet was unquestionably greatest on November 22, when he was able to see it with the aperture stopped down to 3½ inches. The next night, under comparable atmospheric conditions, it was quite inconspicuous even with the full aperture. Again, on December 6, with a very clear and transparent sky, he was unable to see the comet with the aperture at $4\frac{1}{2}$ inches, and he estimates that its magnitude was not greater than 11·5 or 12·0; but on December 8 it was again brighter, the magnitude being estimated to be about 10·5 or 11·0.

On January 28·1 the comet will be in conjunction with, and 3° 48′ north of, Saturn; its conjunction with Mars occurred on January 15, when the actual distance separating the two bodies, about 37 million miles, was at its minimum value.

In a letter to the *Times* of January 14, the Earl of Crawford points out that for ages the sudden appearance of a great comet has been held to herald some great disaster or revolution. This view of the matter may still appeal to the native races of such countries as Morocco, Egypt, or India, where considerable unrest already prevails, and might be used by fanatical agitators to stir up further trouble. He suggests that the communication of a series of popular articles, written in the vernacular, to the native Press, might be beneficial. By announcing and welcoming the appearance of the comet, such articles would forestall the potential mischief-makers and render futile their possible announcements of supernatural manifestations.

The Spectra of Comets' Tails.—The observations of Deslandres, Evershed, Chrétien and others showed that in the spectra of the tails of Daniel's and Morehouse's comets there were certain radiations which were feeble in the heads but extended to considerable distances in the tails of those comets; the wave-lengths of the three strongest bands were about 402, 426, and 455, but no terrestrial origin could be found for them.

This has now been done by Prof. A. Fowler, who has succeeded in reproducing them terrestrially in the spectrum of the glow from vacuum tubes which were known to contain carbon compounds at extremely low pressures, 0·01 mm. or less. Further experiments are necessary to determine what particular form, or compound, of carbon is involved, but from the wave-lengths and the reproductions of the spectra published in No. 2, vol. lxx., of the Monthly Notices there can be no doubt that Prof. Fowler has succeeded in reproducing, in his laboratory, the conditions which obtained in the tails of the two comets mentioned above.

Two Curiously Similar Spectroscopic Binaries.—When Messrs. Plaskett and Harper, of the Ottawa Observatory, published the determined orbit of the spectroscopic binary ι Orionis, the apparent presence of a secondary disturbance was not discussed, because the lines of the spectrum are too diffuse to justify any final conclusions; but the recent determination of the orbit of another binary, B.D. − 1°·1004, showed that a similar case of secondary disturbance appeared there, and it was deemed desirable to make refined least-square solutions for both orbits.

The results show that the two binaries are remarkably alike. Both are in Orion, within 5° of each other, and both are helium stars; the periods are 29·136 and 27·160 days respectively, and the eccentricity of both orbits is abnormally high (0·74 and 0·76) for spectroscopic binaries. Other features are also very similar, but the most striking similarity is in the secondary disturbances, which are almost identical in period, amplitude, and phase. The period of the secondary in each case is the same as the period of the primary, a novel feature in spectroscopic binaries. It seems probable that the same physical cause is operative in both cases, but what it is is difficult to say; the orbital revolution of the system, produced possibly by a resisting medium or by tidal action, is tentatively suggested (*Astrophysical Journal*, vol. xxx., No. 5, p. 373).

The "Annuaire Astronomique," Belgium.—The "Annuaire Astronomique," for 1910, of the Royal Observatory of Belgium contains, besides the usual tables, ephemerides, &c., a number of useful notes and diagrams; among the latter is a coloured chart showing the official standard times of various countries. A list of observatories is also given, and special articles are contributed by various members of the staff of Uccle Observatory.

THE EVOLUTION OF THE BRAIN.[1]

As the result of the investigations carried on in the Museum of the Royal College of Surgeons during the last seventy-five years by its conservators and those who have drawn their inspiration, directly or indirectly, from the work done in the museum, it has become possible to establish on a firm basis the criteria for instituting exact comparisons of the structure of the brain in the various groups of Vertebrata.

This analytical work has now been carried far enough to justify us in attempting a synthesis of our knowledge of the evolution of the cerebral cortex. The special aim of such a research is to investigate the nature of the factors and the circumstances which have brought into being the neopallium, the part of the nervous system which, more than any other, is responsible for the kaleidoscopic manifestations of psychical activities, and the possession of which has made the Mammalia what they are, and given them the dominant position in the animal kingdom.

At the very root of the Vertebrata we find that Petromyzon has a cerebral hemisphere no larger than the olfactory bulb of which it is little more than an appendage. Direct nerve tracts pour smell-impressions into almost every part of the surface of this hemisphere. The cerebrum at its commencement is thus almost purely an instrument for the reception and the conscious appreciation of stimuli evoked by odoriferous particles, and, in the second place, for providing the means whereby the physiological processes underlying this state of consciousness may affect the rest of the nervous system, and through it influence the behaviour of the lamprey itself. It is just possible that even in this lowly vertebrate gustatory fibres brought up to the lobus inferior (of the fore-brain) from the terminal nuclei of the seventh and ninth nerves may make their way into the primitive cerebral hemisphere, but it is still uncertain whether the lobus inferior itself may not be the place where impressions of smell and taste meet.

Even in Petromyzon there is some indication of a differentiation of the hemisphere into a superficial cortical layer (tuberculum olfactorium) and a deeper ganglionic part (corpus striatum), and there is also some slight trace at the extreme dorso-mesial edge of the presence of a small rudiment of the pallium. The tuberculum olfactorium in the Selachii assumes a definite cortex-like arrangement of cells, and is now recognisable as one of the receptive apparatus for olfactory impulses coming directly from the olfactory bulb. The corpus striatum does not receive any direct olfactory fibres; it is the part of the hemisphere which receives afferent fibres from the tuberculum olfactorium, and possibly also from more caudally situated regions of the brain—almost certainly gustatory fibres from the lobus inferior—and it emits efferent fibres, which pass to the hypothalamus and indirectly influence the executive mechanisms of the body, *i.e.* its functions find expression in the behaviour of the animal.

In some of the Selachii the dorsal part of the hemisphere is definitely transformed into a cortical area or formatio pallialis. In Petromyzon there is still room for doubt as to the existence of any such structure, but when we turn to the study of the brain in some of the sharks there can be no doubt of the existence of a considerable area of primordial pallium. There is every reason to believe that this pallial formation represents the undifferentiated rudiment of the *whole* pallium of the higher vertebrates. Its mesial edge ultimately becomes specialised to form the hippocampus, which in the higher Vertebrata does not receive smell-impulses directly from the olfactory bulb, but indirectly through the intermediation of the olfactory peduncle and tuberculum olfactorium on the mesial side, and of the pyriform on the lateral side. The lateral edge of the pallium eventually develops into the pyriform lobe, which continues to receive olfactory impressions direct from the bulb. Much later on, only, in fact, when the mammal appears on the scene, the pallial area intervening between the hippocampus and the pyriform lobe becomes specialised to form the neopallium. It is only right to say that this view of the nature of the primitive pallium differs fundamentally from the various interpretations now being urged by other biologists.

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[1] Summary of Three "Arris and Gale Lectures" on "Some Problems relating to the Evolution of the Brain," delivered in the Royal College of Surgeons on December 13, 15, and 17, 1909, by Prof. G. Elliot Smith F.R.S.

Putting aside the condition of affairs found in all other Ichthyopsida, the consideration of which would be confusing unless there were time to discuss their morphology in some detail, let us look for a moment at the brain of the Dipnoi. In the mud-fish the cortex-like material forming the tuberculum olfactorium becomes highly specialised, and forms a relatively enormous organ upon the basal aspect of the cerebral hemisphere, of which it constitutes more than half the bulk. The pallial formation also becomes more distinctly differentiated into a cortex, the lateral part of which can now be justly termed "pyriform" and the mesial "hippocampal." The fornix-fibres connected with the latter are embedded in a mass of ganglionic matter—the paraterminal body—which exhibits a functional relationship to the hippocampus analogous to that which the striate body presents to the other cortical areas. In other words, it is a nucleus of origin for large numbers of projection fibres which pass down to the hypothalamic region, and the cells of origin of these fibres are probably under the influence both of descending hippocampal (smell) fibres and ascending tracts from the lobus inferior of the hypothalamus (probably taste).

Leaving the Amphibia out of account, and turning at one step from the Dipnoi directly to the reptiles, it will be found that the highly developed tuberculum olfactorium of the Dipnoi has undergone a great diminution in size and an even more pronounced deterioration in structure, but the corpus striatum and the pallial formation show a great advance both in size and in specialisation of structure.

There are very definite reasons for rejecting the views of Ramon y Cajal as to the homology of the mesial wall of the reptilian hemisphere, and also von Kupffer's identification of the hippocampus. Nor can we accept in its entirety the interpretation of the limits of the hippocampal formation and of its constituent parts favoured by Edinger and Ariëns-Kappers.

The hippocampal formation of the reptile is *not* broken up into two parts, fascia dentata and hippocampus *sensu stricto*, as it is in the mammal, but is a continuous column of cells, as the lecturer pointed out in 1895—an opinion since confirmed by Giuseppe Levi.

But there is no fully differentiated fascia dentata in reptiles as Levi believes. The hippocampal formation of a lizard contains cells analogous to those of the fascia dentata *intermingled with* others like those of the hippocampus *sensu stricto*, and others, again, intermediate in structure between the two. Thus in the reptile the hippocampal formation is caught, as it were, in the act of differentiating. Ultimately (in mammals) all the hippocampal cells vanish from its mesial part, leaving only "dentate" cells, which form a receptive organ for incoming olfactory impulses, and the lateral (dorsal) part of the formation loses all its "dentate" cells and becomes a purely associative and projection-organ.

In reptiles, the larger size of the corpus striatum and pallial formation is probably related to the fact that many sensory fibres ascending from the optic thalamus make their way into the hemisphere. The researches of Edinger, Wallenberg, Gordon Holmes, Ariëns-Kappers and others, have made it appear most likely that these fibres carry tactile impressions from the tongue and the cutaneous areas around the mouth, and possibly also visual impulses.

These two categories of fibres are certainly abundant in the peculiarly aberrant and highly specialised brain of the bird, in which the corpus striatum takes on an enormously enhanced importance and significance, and develops along lines which diverge widely from the stream of mammalian evolution.

In the reptile there is no true neopallium, but great confusion in the relations is produced, because the lateral part of the pallial formation is being suddenly stimulated to expand by the entry of these sensory, and perhaps visual, fibres. The rapidly overgrowing cortex becomes bent into the ventricular cavity to form a pseudo-ganglionic (but really cortical) mass, which Edinger has called Epistriatum.

In the immediate ancestors of mammals the number and variety of sensory paths which found admission into the cerebrum became enormously increased, and led to a further specialisation of the pallial formation, resulting in the birth of the neopallium—a cortical area where all the sensory impulses brought to the cerebral hemisphere along these new channels might be received, be blended in consciousness with those coming from other sense-organs, and leave impressions which might be stored, as it were, in this neopallium, and so influence other sensations and states of consciousness at some subsequent time. The neopallium is thus the organ of associative memory.

It is, perhaps, not devoid of significance that the first appearance of a definite neopallium coincides with the transformation of the skin over the whole surface of the body into a highly specialised tactile organ.

The further evolution of the neopallium in the Mammalia, and the formation of sulci and convolutions, was also discussed, special stress being laid upon the value of the unrivalled collection of brains in the college museum for the study of this aspect of the subject.

CONFERENCES ON SCIENCE AND MATHEMATICS IN SCHOOLS.

THE Mathematical Association and the Public Schools Science Masters joined forces at their annual meetings held this month at Westminster School. We print below a programme of the proceedings, and attempt to indicate the present situation of science and mathematical teaching in relation to the work of these associations, following lines of thought prompted by the expression of opinion at the meetings.

We must first discriminate between the Mathematical Society and the Mathematical Association. The former body is devoted to research, the latter to the improvement of elementary mathematical teaching. The organ of the association is the *Mathematical Gazette*; one hears complaints that disproportionate space is given in its columns to problems of purely mathematical interest or to minutiæ, while the clamant need for reconsidering the bases of one of the fundamental branches of education remains unsatisfied.

In the course of a vigorous presidential address, Prof. Turner spoke of the reign of efficiency established in the department of Egyptian service under Captain Lyons. For responsible work of varied nature Captain Lyons selected able mathematicians from Oxford and Cambridge. These men proved successful, and Prof. Turner directed attention to this fact in support of his opinion that it is a mistake to strive after a "general education" for all boys. A gardener might as well treat his flowers as cabbages. In the paper which followed, Mr. Godfrey emphasised the importance of paying regard to the different requirements of students. The precise value of algebra in education deserved greater consideration. The remaining papers hardly provided such nutrient fare as one would wish for on an occasion when masters and mistresses from schools all over the country are summoned for annual conference. In the afternoon, however, a crowded meeting discussed the urgent problem of how to correlate mathematical and science teaching, an important report serving as the basis of debate. The committee responsible for the report consisted of six representatives of mathematical teaching, six of science, and two head-masters of preparatory schools. They had been asked to consider the possibility of correlating the teaching of mathematics and science, and their reply took the effective form of a series of recommendations for putting such correlation into practice. As might be expected from the composition of the committee, all the recommendations were evidently the outcome of practical experience in the class-room. The prime necessity was cooperation between the teachers of the respective branches, and it was recognised that the chief obstacle was the lack of laboratory training, which was, unfortunately, so common amongst mathematicians. To aid in removing this obstacle, an appendix was devoted to the vacation course in practical work organised for schoolmasters at the Cavendish Laboratory; the course was given last August, and is to be repeated next summer.

Many of the recommendations are commendable, *e.g.* that the practical measurements should have a real connection, not only with the ordinary arithmetical lessons, but also with the actual details of daily life. Nevertheless the general impression conveyed is disappointing. A prefatory memorandum warns the reader that the committee regarded as outside its purview the discussion of the functions of science and mathematics in a balanced education. This estimate of its duties appears to account for the limited view which detracts from some portions of their work. We recognise the right of the committee to formulate opinions directly contravening the principles of Prof. Perry, but it should be made clear that the committee has considered the methods advocated by men of no little experience and judgment with whom it disagrees. Again, there is a half-heartedness in some of the proposals which suggests that the committee has not yet advanced to the position taken by leading writers more than twenty years ago. For example, no reference whatever is made to graphs, and the official dictum of the Mathematical Association still stands "that it is undesirable (at the preparatory stage) to lay stress on the *practical employment* of graphs in solving equations or other problems." [The italics are in the original, *vide* Reports of the Committee of the M.A., p. 29 of the 1908 issue.]

The discussion was preceded by an eloquent benedictory address from Prof. Forsyth. He quoted Faraday's advice to Tyndall to work out any experimental result so far as possible, "so that the mathematicians may be able to take it up." Much good would accrue to the training of schoolboys if scientific results could be so left that mathematicians, even mathematical schoolboys, could "take them up." Prof. Forsyth also quoted from the regulations for the Mathematical Tripos to show that settled thought at Cambridge is in harmony with the spirit which animated the joint committee whose report was before the meeting. He pleaded for patience in early years of growth—"go gently, and you will go safely; go safely, and you will go far." It was plain from the speeches of Mr. Godfrey and Mr. Jackson that the committee had exercised much restraint, and that it had deliberately erred on the side of caution in the changes which were recommended.

Sir J. J. Thomson said exactly what was wanted. He amused the meeting by his description of the student at Cambridge who wanted a kind of physics that would not give a headache to a caterpillar, and of the delight and surprise of the mathematician at finding in the laboratory that the formulæ on which he had been working for many years bore some approximation to truth. He hoped the effect of the report would be to increase the belief of mathematicians in applied mathematics. In schools, mathematics and physics should go together almost from the beginning. It was necessary to make men believe in their mathematics. Was it necessary that mathematical masters should teach so little mathematics?

We have dwelt upon some of the weak points because, in our view, the present condition of mathematical teaching in schools calls loudly for reform, in which the Mathematical Association should take the lead. But it would be utterly unfair and untrue to describe either the report or the meeting as less than a success. Prof. Forsyth paid a well-merited tribute to the committee for the careful inquiries it had instituted and carried to completion, and for the practical character of its proposals. The meeting was crowded, and there was no hint of opposition to the work of correlation. The following resolution was passed without dissent and with heartiness:—"That this meeting is in sympathy with the attempt embodied in the present report to correlate more closely the teaching of mathematics and science."

The principal feature of the Science Masters' meeting was the president's address, entitled "The Future of Science in our Schools—their Complete Re-organisation a Necessity." Prof. Armstrong said that the men most competent to take charge of the schools in the future would be the science masters, it being their business to study method and to be practical, therefore to solve problems and to lead. Referring to compulsory Greek, he declared that Oxford insists upon lowering the moral tone of entrants upon university life by enforcing a test which is known to be farcical and futile, known to be one which spoils young lives in preparatory schools; and doctors of divinity in charge of our schools smile blandly at such proceedings.

The teaching of science in our schools should consist primarily of instruction in the art of inquiry. Our failure to make science teaching effective is due to a misunderstanding of what an experiment is. To speak of *showing* an experiment is a negation of terms—actually, a demonstration is given. Moreover, we begin too late; the child's desire to observe and experiment, to reason on the basis of observations made and from the results of experimental inquiry, must be fostered in every way. Mr. Lyttelton, in "Schools and Schoolboys," proposes that there should be no "science proper" in the earlier years of school life. "My contention," said Prof. Armstrong, "is that there should be little else than *proper science*; but then my definition of science is 'the business of knowing.'"

In order to develop the right attitude of mind in our pupils, we must despecialise our science teaching as well as our curriculum as a whole. Work must begin with practical arithmetic, dealing with materials of natural origin and ready to hand. The natural history of the garden pebble may provide the first steps in geology, physiography, and physics. When common materials have been studied—mainly from the physical point of view—it will be time to lay the foundations of chemical belief, and the rusting of iron (leading to combustion) and the study of limestone (leading to acidic and alkylic oxides) provide a good approach. The conception of structure should be developed by the thorough study of alcohol (leading to food and its functions). Plant life, and, later, human anatomy, should be studied, nor should Darwin's work be neglected. Every person of intelligence must be able to appreciate common natural objects and phenomena. Since the work must be done by the boys themselves, a revolution in school procedure will be needed, and science masters should be revolutionaries.

Our space does not admit further excerpts from this comprehensive address. We endorse many, but not all, of Prof. Armstrong's opinions; we give him credit for rendering to the association the service most needed at the present hour. Nothing can better promote educational efficiency than to force schoolmasters into a position of preparedness to give a considered judgment upon the *broader issues* involved in the organisation of curricula and methods—what to teach, why to teach it, and how. If teachers cannot become professionally articulate, these questions will be decided by amateur or professional organisers without their guidance and with disastrous national results.

The programme of the meetings was as follows:—

January 12, Mathematical Association:—President's address, by Prof. H. H. Turner; (2) Mr. C. Godfrey on different methods of teaching algebra for different classes of students; (3) Prof. P. J. Harding on elliptic trammels and Fagnano points; (4) Mr. W. J. Dobbs on an inexpensive balance; (5) Rev. J. J. Milne on the geometric interpretation of homographic equations and their application to loci; (6) Mr. T. J. Garstang on alternatives to Euclid's parallel postulate.

Mathematical and Science Masters' joint meeting:—(1) Address from the chair by Prof. Forsyth; (2) report on correlation of mathematical and science teaching, presented by Mr. C. Godfrey and Mr. D. Berridge.

January 13, Science Masters' Association:—(1) President's address, by Prof. H. E. Armstrong; (2) Mr. J. R. Eccles on simplification of symbols in physics text-books; (3) Mr. L. Cumming on advisability of teaching all boys the elements of geology and biology; (4) Mr. W. E. Cross on laboratory equipment and design; (5) Mr. F. M. Oldham on the teaching of oxidation and reduction.

There was an exhibition of apparatus and books. The apparatus of leading firms displayed steady improvement in working qualities, and received considerable attention. Sir E. Ray Lankester is the president-elect for the year 1911.

G. F. D.

NORTH OF ENGLAND EDUCATION CONFERENCE.

THE conference which met on January 6–8 in the buildings of the University of Leeds, under the presidency of Sir Nathan Bodington, Vice-Chancellor of the University, was the eighth of a series of meetings which have been annually convened in the larger centres of the north of England. There was a large attendance of teachers, administrators, and members of education committees, the total falling little short of 2000 persons. The publishers' exhibition in connection with the conference was frequented throughout each day, and the papers which were read were followed with interest by large audiences, and gave rise to a number of animated discussions.

Prof. Sadler opened on the morning of January 7 with an examination of "The Relation of Elementary Schools to Technical Schools, Day and Evening." An abridgment of his paper appeared in NATURE of January 13, so it is unnecessary to make more than a brief reference to it here.

Some of the chief difficulties in the way of further education for children from primary schools were traced by Prof. Sadler to the snapping by the factories of the educational tradition associated with the old apprenticeship system. Too many English parents now think that a child's education ends when he leaves the elementary day school, while our employers and foremen have lost the sense of responsibility for the further education of the young people in their employment. Substantial reform can only be attained after a completion of the change in public opinion now in progress, and by the re-enlistment of the great employers to the cause of continued education. As regards the legislative measures that will eventually be required to extend the powers of local authorities in dealing with technical continuation classes, and to secure regularity of attendance, Prof. Sadler advocated the recommendations of the Consultative Committee of the Board of Education.

Mr. James Baker contributed to this discussion an account of the system of continuation schools in Austria, from which it appears that apprentices to a great variety of trades are bound to attend regularly the industrial schools of their townships after leaving the elementary schools at the age of fourteen, and that employers are bound to allow the necessary time for such attendance.

Mr. J. H. Reynolds urged that the half-time system demanded by employers must be postponed until after the children's fourteenth year.

On Friday afternoon, January 7, Mr. Max Muspratt, J.P., C.C., opened the discussion on cooperation between employers and education authorities. He cited (as Prof. Sadler had also done) the example of certain large firms (Messrs. Brunner, Mond and Co., Northwich; Messrs. Lever Brothers, Port Sunlight; and the United Alkali Co., Widnes) the directors of which bound all their young employees to attend evening classes up to the age of eighteen or nineteen, the firms paying the fees. This system of friendly compulsion is rendered possible by the fact that the large works in question practically monopolise the labour market in their respective areas; but in the larger towns, owing to the difficulty of bringing the hundreds of offices and firms into line, the only solution is to give powers to local authorities to start some form of compulsory attendance at evening schools up to the age of sixteen for office boys and apprentices. In Liverpool the big engineering shops, *e.g.* of the Dock Board and the White Star and Cunard lines, offer a variety of inducements to apprentices to continue their education, and a similar beginning has been made in a variety of other trades (building, painting, plumbing, &c.).

Mr. V. A. Mundella described the scheme under which the Associations of Shipbuilders and Engineers of Sunderland cooperate with the Sunderland Technical College in the training of engineering apprentices.

Mr. R. Wallace, of the Wallsend Shipway and Engineering Company, and vice-chairman of the Wallsend Education Committee, said that any attempt to educate the masses beyond their capabilities would not benefit them, and would be a waste of the nation's resources. They were dissatisfied with elementary education, and with good cause. What they needed was skilled handicraftsmen.

On the morning of January 8 Mr. J. C. Medd opened the discussion on "Education Abroad and in England," and we hope to find space for an abridgment of his paper in another issue. Mr. Medd considers that the facilities for technical and scientific instruction are as great in England as in Germany, but the German has the advantage in the better quality of the pupils who attend those colleges and schools. In elementary education there is a great need for more practical instruction, some relaxation of the regulations as to building and equipment for manual instruction and domestic science, and the introduction of a system of supplementary courses.

Mr. Otto Siepmann attributed the high average excellence of elementary education in Germany partly to the thorough six-years' training which intending teachers receive in the training colleges, and partly to the fact that the field from which the teachers are drawn is not denuded of its most gifted scholars by any "educational ladder" which leads to other spheres of activity. In the secondary schools, also, individual prominence is sacrificed to raise the common average. All subjects are done in form, and practically the whole form is promoted from one stage to the next. Thus a particular aptitude for a special subject is never developed at school, but the German system ensures for every boy a sound general education. At the universities all this is changed, and the freedom which students are allowed in the choice of subjects, the general lack of supervision and of interim examinations, react favourably upon their work. They carry into life an active interest in some branch of knowledge, which they frequently pursue as long as they live.

Limitations of space prevent any reference to the discussions on art subjects and physical training, and allow merely brief reference to two other topics.

Miss Burstall admitted that the young people who now leave our secondary schools are to a large extent lacking in self-reliance and the power of independent work. She attributes this result to the pressure of the examination system, which forces the teacher, almost in self-defence, to do for the children half the work of gaining, arranging, and applying knowledge. Independent work by the scholars requires more time, which can be got only by reducing the number of subjects studied in any one year. The first thing to aim at, therefore, is to lighten the pressure of examinations.

Mr. W. B. Steer urged that much could be done to encourage independent habits of study by substituting silent reading, followed by keen questioning, for the ordinary reading lesson. At present excessive teaching leaves scant time for learning. Mr. E. E. Unwin spoke of the leisure-hour work and other forms of independent study practised in Bootham School, York.

On "The Relation of the State to the Training of Teachers of Domestic Subjects, and their Relation to the University," Prof. Smithells urged that the time had come for incorporating the training schools of cookery and other domestic subjects in an improved scheme for the general training of teachers, and for treating this important branch of work with less parsimony than hitherto. The domestic training schools should form an integral part of the women's training colleges, though not necessarily in the same building. At the same time, there was no reason except that of expense why a fuller curriculum of training in branches of knowledge relating to these subjects should not be provided in our modern universities, which already function as day training colleges for teachers seeking a more extended knowledge and the attendant degree in arts or science.

Miss M. Atkinson spoke of the introduction in London King's College for Women of two courses in domestic science, one for undergraduates and the other for post-graduate students. It was necessary in domestic economy to draw a sharp line somewhere between the minimum of hygienic knowledge and domestic skill, which should form a part of the education of everyone, and the specialised technique to be demanded of those who proposed to be experts in the subject; but in regard to the latter class especially, the basis of the training should be real and not sham science. The preliminary studies in physics, chemistry, physiology, and economics should consequently be provided by first-year courses at the university in these subjects, exactly as for students of engineering or medicine.

THE ETHNOLOGY OF CALIFORNIA.

THE University of California, continuing its useful work of investigating the ethnology and languages of the now rapidly disappearing Indian tribes of that State, publishes in the third part of the fifth volume of its Proceedings a monograph, by Mr. P. E. Goddard, on the Kato tribe, a branch of the Athapascan race on the Eel River. They have undoubtedly assimilated much of their culture from contact with the Pomos to the south and the Yukis to the east and west; but they still retain so much of their primitive folk-lore and beliefs that they deserve special examination. While their legends of the origin of fire and the sun are more or less common to other members of the group, their accounts of the creation and the deluge are peculiar to themselves. In the first, the earth with its great long horns raises itself from the primeval waters. The god Nagaitcho takes his seat upon it, places its head in the direction in which it should lie, and spreads clay between its eyes and upon each horn. Finally, in this he plants trees and other vegetables, and moulds the mountains and valleys.

In a second myth the gods Nagaitcho and Thunder cause the old, worn-out sky to fall, and replace it with a new firmament with four portals and four supporting columns, preparing at the same time summer and winter trails for the sun. Then follows a deluge, and the creation of fish and beasts of the sea. They then make man out of clay and woman out of one of his legs. In another myth Coyote steals the sun, which he finds tied up in a blanket in the house of an old woman. Out of pieces of the sun he creates the moon and stars. This series of myths, with other folk-tales, has been taken down from the lips of Bill Ray, who is apparently the last member of the tribe acquainted with the race traditions. Mr. Goddard has published the legends in the native language with an interlinear translation, and adds a free version which renders them intelligible. He admits that the record is fragmentary, and that they have probably lost some of their primitive form; but even with this qualification they will prove of interest to students of comparative mythology.

SOME APPLICATIONS OF MICROSCOPY TO MODERN SCIENCE AND PRACTICAL KNOWLEDGE.[1]

THE time is past when a man can expect to make any real contribution to knowledge by spreading his observations over the whole vast range of microscopic objects. In these days, in which the output of research on every subject is enormous, and is increasing rather than diminishing, a man is more likely to make progress and do useful work by taking up a special line and sticking to it. Speaking for those who work *with*, rather than *at*, the microscope, I would advise everyone who wishes his work to be fruitful in results to have a hobby of his own. In making this suggestion, I do not mean that we are all to become narrow specialists, interested in nothing but our own particular subject. Specialisation in work and in research does not necessarily mean specialisation in knowledge or in interests. The great value of such a club as ours is that by bringing together people occupied in different branches of work it enables one man to know what another man is achieving in a different line, thereby at once widening his outlook and stimulating him in his own work by producing a healthy spirit of emulation.

My advice, therefore, to the microscopist would be that he should aim at wide knowledge and diffuse interests, but should concentrate his activities and focus his attention on his own particular pet hobby, so that, by mastering a branch of natural knowledge, he may find himself in a position to advance it. However limited the field of study may be, however insignificant the objects may appear, yet something can always be found which, on the one hand, will illustrate some important and fundamental principle, or, on the other, will prove ultimately to have some direct or indirect bearing on human life and its needs. Let me give two instances in support of this statement. To the so-called practical man it may seem a very trivial occupation to worry about such things as Foraminifera, however beautiful their shells may be. Yet these tiny creatures, living in a sphere apparently so remote from our own, furnish wonderful illustrations of the powers and activities of primitive living matter, and Mr. Earland has recently directed our attention to the remarkable property they exhibit of selecting particular materials for building up their houses. This is a most interesting fact, well worthy of further study, especially by experimental methods, for it indicates that the most primitive and formless living matter possesses faculties of a kind which we term in higher forms of life instinct or intelligence. Again, a reputation for being an expert on, let us say, fleas, may provoke a smile from the uninstructed; but in view of the proved connection between fleas and human disease, especially plague, these paltry insects have now assumed very great importance as objects of study, and we find detailed descriptions of them in the reports of Government commissions. As Lord Crewe remarked in a recent speech, we commonly speak of any very trivial annoyance as a flea-bite; but we know now that in certain circumstances a flea-bite may cost a man his life. Small wonder, then, that fleas have become important objects of study to mankind.

This question of fleas and plague reminds me that I am here, not to preach a sermon, but to give an address, by recalling to my mind the subject which I propose to discuss to-night, namely, some of the remarkable advances that have been made during the last few years in our knowledge of human diseases caused by microscopic parasites. This is a subject which has now grown to such vast proportions that I must confine myself of necessity to a small part of it, namely, the diseases caused by Protozoa. As examples, I shall deal more especially with malaria, sleeping sickness, and yellow fever.

Malaria is a disease which was well known to the ancients, and is still very rife in many parts of Europe. It appears to have been prevalent formerly in the fen districts of England, but to have died out there from some unexplained reason. It is estimated by Prof. Ronald Ross to cause from a quarter to half the total disease in the tropics. It occurs under at least three forms, known commonly as tertian, quartan, and pernicious malaria, each of them easily distinguishable clinically, and due to distinct species of the parasite differing from one another in morphological characters, but similar in the general features of their life-cycle.

Until comparatively recent times nothing whatever was known of the nature of malaria or the manner in which it was acquired. It was generally believed that it was due to a poisonous miasma which arose from swamps and marshes, a notion conveyed in the name malaria—"bad air." This miasma theory is very prevalent in literature; for instance, in such a work as Dickens's "Martin Chuzzlewit," where the unfortunate settlers in Eden are supposed to contract fever by breathing the exhalations of the swamps.

The scientific study of malaria may be dated from 1880, when the parasite was discovered in the blood of fever patients by Laveran, then a military surgeon in Algiers. Laveran examined the blood microscopically, and observed the principal phases of the parasite. It was, however, some years before Laveran's parasite was accepted as the cause of malaria, though it ultimately obtained universal recognition. Even then it remained a mystery how the parasite got into the blood, and many still held to the miasma theory. It was supposed by some that the parasite passed out of the body and produced cysts or spores which could be disseminated by the wind, just as the cysts of many Infusoria are known to be carried by aërial currents, and that by inhaling these air-borne germs the disease was acquired. Others sought for the source of the infection in the contamination of drinking-water.

It remained for a countryman of ours to discover the true method of infection. Prof. Ronald Ross, then in the Indian Medical Service, experimented first with the very similar malarial parasites of birds, and found that the infection was taken from one bird to another by mosquitoes of the genus Culex. Similar experiments on human malaria gave at first negative results, until it was discovered that the necessary intermediate host of human malaria was a mosquito belonging to quite a different genus, Anopheles. These experiments were confirmed by many investigators in all parts of the world, and led to results which may be stated in two propositions, one positive, one negative, first premising that by a malarial infection is meant a new infection, not a relapse in a person previously infected.

(1) Malaria can be and is conveyed from sick to healthy persons by the agency of mosquitoes.

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[1] From the presidential address delivered to the Quekett Microscopical Club on May 7, 1909, by Prof. E. A. Minchin, and published in the Journal of the Club for November, 1909.

(2) Malarial infection is not known to take place by any other method.

Experiments further showed, as I have mentioned already, the very remarkable fact that avian malaria can only be transmitted by culicine mosquitoes, and human malaria only by anopheline. If human blood containing the parasite be taken up by a Culex, the parasite cannot develop, but is digested up, along with the blood. The same thing happens to the parasite of avian malaria when taken up by an Anopheles.

Following on these experimental discoveries, the development of the parasite was studied microscopically in all countries by a great number of observers, amongst whom we may mention especially Grassi in Italy and Schaudinn in Germany. By their combined labours the complete life-history of the parasite has been worked out in the greatest detail, revealing one of the most fascinating chapters in natural history.

(An account was then given of the development of the malarial parasite, illustrated by a diagram.)

My second example, sleeping sickness, is also a disease that has been long known, though without attracting, until recently, so much attention as malaria. It was first observed in the West Indies in negro slaves imported from the west coast of Africa, the region in which it appears to be endemic. It was observed that the negroes suffering from it were not infectious, and that the disease did not spread to others—a fact easily explained by what is now known about the transmission of sleeping sickness, namely, that it is effected by flies of the genus Glossina, commonly known as tsetse-flies, which are confined at the present time to the African continent.

Of recent years this previously obscure disease has forced itself on the public attention by its having spread from its native haunts on the west of Africa and invaded regions previously free from its presence. In our protectorate of Uganda, in particular, it has caused terrible mortality, completely extirpating the natives in some parts, and numbering also many Europeans amongst its victims. I do not propose here to enter into the distressing symptoms of this deadly disease, but only to deal with what may be termed its natural history.

Before it is possible to understand clearly the nature of sleeping sickness it is necessary to say a few words about similar diseases in animals. It was well known to all African travellers from the time of Livingstone that domestic animals, especially cattle, horses, and dogs, were liable in Africa to a peculiar fatal disease known as nagana, caused by the bite of blood-sucking flies of the genus Glossina, the tsetse-flies, of which there are several species abundant in various parts of Africa. It was supposed that the fly produced and injected a virus which caused the disease.

The nature of nagana was first made clear by Sir David Bruce, who found that the cause of the disease was the presence in the blood of a minute flagellate or trypanosome, since named *Trypanosoma brucii*, and that the tsetse-fly did not generate the parasite, but was merely the unwitting agent in transmitting it from infected to healthy animals.

When the epidemic of sleeping sickness broke out in Uganda, the Royal Society, at the request of the Government, appointed a commission to investigate it, and Sir David Bruce was sent out as a member of the commission. A trypanosome was found by Castellani in the cerebro-spinal fluid of sleeping-sickness patients, and it was shown by Bruce and his assistants that this trypanosome was the cause of the disease, and that it was transmitted from sick to healthy persons by the bite of the local species of tsetse-fly, *Glossina palpalis*. It was proved by subsequent researches that the trypanosome causing sleeping sickness was identical with one that had been discovered previously in the blood of negroes in Gambia, and named *T. gambiense* by Dutton. In short, it was proved that sleeping sickness of man is a trypanosome disease similar to nagana of animals, but produced by a different species of trypanosome, transmitted by a different species of tsetse-fly, and running a somewhat different course. Whereas *Trypanosoma brucii* remains in the blood of its victims until their death, *T. gambiense* is found in the blood in the early stages of the disease, but spreads, probably through the lymphatic channels, into the cerebro-spinal fluid, and then causes the peculiar nervous symptoms which give the disease its name. The rapid spread of sleeping sickness into regions where it was previously unknown is an indirect consequence of the occupation of the African continent by European Powers. Formerly the native tribes were constantly at war with one another, and a negro never travelled any great distance from his own village. Now caravans move in every direction, and doubtless in this way the disease has been spread by porters and other natives already infected with the trypanosome coming into regions where tsetse-flies abound, and there infecting the flies, which in their turn have disseminated the infection amongst the previously healthy population.

Although it was proved experimentally that the disease is propagated by tsetse-flies, the exact method by which this is effected has remained hitherto somewhat mysterious. It was proved that the infection could be conveyed by what may be termed the direct mechanical method; that is to say, if a fly has sucked recently the blood of an infected person, its proboscis may contain living trypanosomes, and if it inserts its proboscis, immediately or a short time afterwards, into the skin of a healthy person, it may convey the infection simply by means of its contaminated proboscis. Experiments showed that infection in this direct manner only took place up to forty-eight hours after the fly had fed on the infected subject, and all attempts to obtain infection with flies at a longer interval than forty-eight hours gave negative results. Experimental evidence was therefore lacking for the existence of a developmental cycle of the parasite in the fly, although it was argued by many writers that for various reasons such a cycle must exist. Quite recently, however, a positive result has been obtained by Prof. Kleine, director of the German Sleeping Sickness Commission in German East Africa. Experimenting with nagana by feeding a batch of flies first on an infected animal and then on a long succession of healthy animals, he has made the most interesting and important discovery that the flies are not infectious at all until some three weeks after their first feed, and that then they infect every animal upon which they are fed. This result indicates that the incubation period—that is to say, the time occupied by the parasite in its cycle of development in the fly—is far longer than anyone had suspected, and that the negative results of former investigators are to be explained by their experiments not having been extended over a sufficiently long period. It must be borne in mind that to those working in tropical Africa it is often difficult, or even impossible, to obtain a sufficient number of experimental animals for such a protracted series of experiments.

From Prof. Kleine's experimental results it is evident that the trypanosome of nagana, and doubtless of sleeping sickness also, does undergo a cycle of development in the tsetse-fly, and the way is now open for the microscopist to rush in and to observe what becomes of the parasite in this long period that elapses between its being taken up by the fly and being given out again. We may expect that a fascinating and wonderful history will be made known of the transformations and migrations, the amours and the increase of the trypanosome in the bowels of the unconscious tsetse-fly; and we seem now to be in sight of a solution to the baffling problem of the transmission of diseases caused by trypanosomes.

The third disease I have chosen for my discourse, namely, yellow fever, is one sufficiently well known to everyone, by repute at least. There is no need for me to describe at length the dreaded "Yellow Jack," a malady often fatal, and always excruciatingly painful. The connection of this disease with mosquitoes has long been suspected, and has recently been proved conclusively by both the American and French commissions sent out to study the disease. The mosquito in this case is neither a Culex nor an Anopheles, but one belonging to a distinct genus, namely, *Stegomyia fasciata*, sometimes called the tiger-mosquito. It has been proved conclusively that the mosquito does transmit yellow fever, and it has also been proved that the disease is not communicated by direct infection or contagion through contaminated clothes or dwellings; and here let me direct attention to one great obstacle to conducting experiments on yellow fever—the fact, namely, that the disease is not communicable to animals, but only, so far as is known, to man. Hence experimental studies on the disease could only be performed on men who offered themselves voluntarily for this purpose. Such experiments were sometimes negative, sometimes positive, in their result; in the latter case, of course, the subject of the experiment acquired the disease, and in one case, at least, died of it. It would require the pen of a Shakespeare or a Milton to do adequate justice to such devotion on the part of these brave men to the cause of science and humanity.

By numerous carefully devised experiments a number of important facts relating to the transmission of yellow fever were elicited. It was shown that the unknown cause of the disease is in the blood of the patient only during the first three days of the illness, so that only during this period can mosquitoes become infected by sucking the blood of the patient. Consequently, if the patient be protected from mosquitoes for the first three days he ceases to be a danger to the community as a source from which the infection can spread. It was shown, further, that the mosquito, after acquiring the infection, goes through an incubation period of from twelve to fourteen days, during which it is not infectious; but after that it is infectious for the rest of its natural life; and a further point of interest was added by the French commission, namely, that an infected mosquito may transmit the infection to its offspring, so that a mosquito which has never fed on an infected person may be congenitally infectious.

I have chosen the instance of yellow fever to put before you because, although we have now such an accurate knowledge, gained by experiment, of the cause and transmission of the disease, no one has succeeded as yet in seeing the parasite itself. It is practically certain, for many reasons, that there is some minute parasite at work, and there are grounds for suspecting that the parasite is a spirochæte, one of those minute, actively flexible, thread-like organisms of which the affinities are so much in dispute at present, and which some authorities class with the Protozoa, others with the Bacteria; but here we have a case where the microscopist has been baffled, and where we get beyond the present limits of the powers of our instrument, a fact which should make us appreciate the labours of those who study the microscope and strive to perfect it.

Did time permit, I might mention many more important discoveries in the field of protozoan parasites causing disease. For example, there are the blood parasites of the genus Piroplasma (Babesia), causing fatal forms of hæmoglobinuria in various animals; they are not yet known for certain in man, but a species is known from monkeys, a source which is getting perilously near to us. Here the agent of infection is a tick of some sort, and usually the infection goes through two generations of ticks, being transmitted from the mother-tick, which has acquired the infection, to the numerous progeny of minute six-legged tick-larvæ, which in their turn infect the vertebrate host. Then there are the relapsing fevers caused by spirochætes in the blood, and said to be transmitted in Europe by bed-bugs, but in Africa by a species of tick which lives in mud floors. In India and other parts of the tropics we find that the deadly disease known as kala azar, due to a parasite, is transmitted in all probability by bed-bugs. All these and many others furnish points of great interest, but I must be content with the three examples with which I have dealt in more detail, in order to show you how great a work has been done and is being done in this field. As Prof. Osler said recently, these discoveries are going to have an enormous influence on the history of the world and of mankind, because they are going to make the tropics habitable by white men. We hear or read so often of such-and-such a country being uninhabitable by Europeans on account of its deadly climate; but when we look into the matter we find that it is not the climate at all that is to blame, but that the white races are killed off by diseases caused by some animal parasite with which they are inoculated by the bite of some bloodthirsty arthropod. Take Uganda, for instance, with which I have a slight acquaintance; all that the climate does for you there is to give you a sunstroke if you go out in the heat of the day with inadequate headgear, and to make it very difficult to keep awake after lunch. Some well-known European diseases, such as small-pox and syphilis, are also rife there; but, on the other hand, some of our familiar plagues, such as tuberculosis, rheumatic fever, and influenza, appear to be absent. The diseases that are really to be feared are all such as spring from bites of arthropods. If you protect yourself from the mosquito you will not get malaria; avoid the tsetse-fly, which is very easily done, and you are safe from sleeping sickness; do not sleep on mud floors, nor pitch your tent on old encampments, and relapsing fever will not trouble you; keep rats and fleas at a distance, and you are safe from plague. With a little care and attention to surroundings the European finds his life in the tropics, if anything, more free from disease than in our temperate but influenza-ridden Palæarctic climate.

In the foregoing remarks I have directed attention more particularly to the practical results of microscopy wedded to sagacious experiment, and have tried to show how fertile in good results this union has been, and promises still to be; but I would not have you go away with the impression that I advocate such studies solely on account of immediate practical good to be derived from them. Far from it. I am one of those who hold so-called theoretical and unpractical studies to be of the highest importance, and worthy of all support, if only for the reason that, being unremunerative, they often cannot support themselves. All history shows us that the knowledge of general principles must precede their application and practice, and that what is purely theoretical in one generation becomes thoroughly practical in the next or in a later one. There is no need for me to waste your time by multiplying instances of this familiar truth; but I will conclude with a few words on the wider applications of microscopy.

In the range of the natural sciences, two branches of knowledge stand at opposite poles, as judged from the standpoint of the objects with which they deal. The science of astronomy deals with the infinitely great; the science of biology, on the other hand, with the infinitely small. The astronomer with his telescope astounds us with the distant worlds he reveals to us; he thinks in millions of miles as ordinary persons deal with feet or yards; and he exhibits to us this world on which we live as but an insignificant planet, one of many, whirling round a star far inferior in magnitude to many of those we see nightly, a tiny speck in the vast ocean of space and matter, peopled by a race of puny creatures who style themselves the lords of creation, although their dominion does not extend over a billionth part of the universe. "The consciousness of an endless series of worlds," said Kant, "destroys my sense of importance, making me only one of the animal creatures which must return its substance again to the planet (that, too, being no more than a point in space) from whence it came, after having been in some unknown way endowed with life for a brief space."

Not less astounding, but in a totally different way, are the revelations of the biologist with his principal instrument of research, the microscope. With this he discovers continually new worlds invisible to the unassisted eye, and reveals infinite complexity in things apparently the most simple. We find, in the first place, our own bodies to be microcosms, small worlds, that is, of such inexhaustible variety and elaboration of detail that to the human mind they are as difficult to comprehend and to realise in their entirety as the macrocosm or great universe itself. We find, further, that each human body, itself appearing as a single individual or unit, is in reality made up of many billions of living units or cells, each as much a microcosm as the whole body; and thus our instrument, the microscope, brings us face to face with the greatest mystery in the whole range of the sciences, namely, the problem of life and living matter. There is, apparently, no gap in nature so profound as that which separates the living from the not-living. The nature of life, its origin and destiny, the laws that govern living matter and vital processes of all kinds, these are of all problems not merely the most fundamental in science and philosophy, but also the most important for our practical knowledge and daily conduct.

It would be futile to assert that human science has as yet made any great advance in elucidating the nature of life. On the contrary, all progress in research only throws into greater relief the difficulty of the problem; the better we become acquainted with it, the more the mystery deepens. Nor would it be right to assert that the microscope is the sole instrument of research in this field. Our knowledge of the properties and activities of the living substance and of living things advances daily by leaps and bounds through methods of investigation in which the microscope plays no part. I have referred to the knowledge that has been gained of the life-history of the parasite of yellow fever, in spite of the fact that the microscope has failed completely, so far, to detect the parasite itself. But we may safely claim that the greater and most important part of modern biological knowledge could not have been gained without the instrument which it is the object and purpose of our club to study, to perfect, and to apply; and, further, that to be able to see the objects with our own eyes makes them much more real and true to us than merely to infer their presence and properties from experiments in the dark, so to speak. "Seeing is believing" is an English proverb which has its counterpart in all languages. We may be satisfied in our minds as to the existence and behaviour of the yellow-fever parasite, but nevertheless its discovery by optical means would be greatly welcomed as an important advance in our knowledge.

There is no greater stimulant to the all-important study of living things than the feeling of wonder and delight which the first sight under the microscope of objects otherwise invisible produces in even the most uninstructed mind. Most of us probably can date our first interest in minute living objects from the time when, perhaps in early youth, we were given, or allowed to use, a microscope, with which we could gratify, without satisfying, our curiosity in looking at all kinds of minute objects. In such an occupation the appetite comes with eating, as the French proverb says, and the instrument which was at first a fascinating toy leads us on until, one might almost say, it masters and enslaves us. In this development there is another instance of the parallel between the progress of the individual and the history of the race. To the majority of early microscopists the microscope was but a toy, an instrument which competed with the magic-lantern as an amusement for drawing-room séances, and only a serious minority made use of it as a means of earnest scientific investigation. There are, perhaps, still microscopists whose chief delight is to thrill their friends, especially those of the fair sex, by the sight of hairs on a spider's leg, or the elephantine proportions of a cheese-mite. If so, let us not scoff, as some do, at the amateur; we ought rather to regard him with the same interest that a zoologist looks on an okapi or a lepidosiren, as a living representative of a bygone age. For the modern microscopist is fearfully in earnest, and has but little opportunity for amusement in pursuing a science which taxes, not only his brain, but his eyes to the utmost. There is scarcely any greater physical strain than the long-continued investigation carried on with the highest powers of the microscope, and in my own experience I have known some who lacked the physical endowment for such work, and others who have been obliged to retire disabled from the field. Let us, then, in a pursuit which but too frequently dulls enthusiasm by fatigue and exhaustion, in which our "native hue of resolution" tends to become "sicklied o'er by the pale cast of thought," rather envy those who retain the freshness of their early delight, and strive to cultivate, rather than to stifle, that feeling of wonder and curiosity which should be the starting point of all philosophical and scientific investigation. "Two things," said Kant, "fill my mind with ever-renewed wonder and awe, the more often and the deeper I dwell on them—the starry vault above me and the moral law within me." I venture to think that had Kant lived in our days he would have found a third source of wonder in the contemplation of the simplest living things as revealed by the microscope, in the combination they present of apparent simplicity with infinite complexity, and of extreme minuteness with the most extraordinary powers. To me the observation of a minute organism, such as an amœba, under the microscope, is in its way as marvellous as the sight of the starry firmament. I see a minute, formless creature, without definite parts or organs, which nevertheless exercises all the functions of life and exhibits the germ of every faculty we possess, and thereby proves that its apparent simplicity and formlessness cloak a complexity of organisation far transcending our powers of observation and eluding our means of detection. What, again, can be more wonderful to contemplate than the fact that peculiarities in the complex mental endowment and physical structure of a human being can be transmitted from one generation to the next through the medium of a spermatozoon, the tiniest cell of the human body, in which the microscope reveals only a structure of the simplest kind? These things must rank with the most wonderful and inexplicable of the phenomena that nature presents to us, and we are as yet only on the threshold of investigation. The stellar universe has been observed, its laws and motions studied, for many thousands of years, but our acquaintance with the beginnings of life and its properties as exhibited by the simplest living things is but an affair of yesterday, as it were, and the scientific study of life is as yet in its infancy.

In these days of vast and rapid increase of knowledge in such matters there is danger that we may lose the true perspective, and that our perception of the whole may be blunted and obscured by the immense mass of detail which forces us to attend only to a small part of our science. It is the special function of a club such as ours to keep fresh our enthusiasm and to enlarge our outlook by contact and intercourse with those working in other fields, to spread the infection, if I may use the term, of intelligent curiosity in the minutest natural objects, and thereby to attract and enlist new workers in a field in which the harvest is plentiful but the labourers are few.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The electors to the Allen scholarship give notice that they are prepared to receive applications from candidates. Any graduate of the University is eligible for the scholarship provided that his age on the first day of the Lent term, 1910, does not exceed twenty-eight years. This year the scholarship is open to candidates who propose to undertake research in any branch of study which comes within the department of any of the following special boards:—medicine, mathematics, physics and chemistry, biology and geology. The scholarship is tenable for one year, during which period it will be the duty of the student to devote himself to research in Cambridge or elsewhere. The emolument of the student is 250*l*., or such smaller sum as the fund, after payment of all expenses, shall be capable of providing. Every candidate must send to the Vice-Chancellor, Pembroke College Lodge, on or before February 15, his name and a definite statement of the course of research which he proposes to undertake, together with such evidence of his qualifications as he thinks proper, and with the names of not more than three referees to whom the electors may apply for information.

THE University of California has received from Mrs. Phœbe Hearst an offer to build, at the cost of about 100,000*l*., a museum for the housing of its anthropological specimens. During the last ten years Mrs. Hearst had already contributed an equal sum to the establishment and maintenance of the University's department of anthropology, and to the cost of its foreign expeditions.

ACCORDING to the Berlin correspondent of the *Times*, the latest returns from the German universities give the total number of students as 52,407, including 1850 women, as compared with a total of 48,730 last year and 32,800 ten years ago. There are also 3314 men and 1923 women attending courses as guests. Berlin takes the first place among the twenty-one universities with 9242 students, as against 8641 last year, and is followed by Munich with 6537, Leipzig with 4761, Bonn with 3652, Breslau with 2405, and Halle with 2393. Göttingen has 2230, and Heidelberg 1934. In Berlin University this winter there are 632 women students, an increase of 232 as compared with last year.

AN address delivered by Prof. Alexander Smith before the section of education of the American Chemical Society at Detroit, and reproduced in a recent number of *Science* under the title "The Rehabilitation of the American College and the Place of Chemistry in It," is of more than local interest and importance. The author is strongly impressed with the difficulty of teaching his subject effectively to classes of students of widely varying mental capacities, and especially of teaching it in such a way as to be of service to those who do not expect to become professional chemists. He is a profound disbeliever in the method of imparting instruction which relies mainly upon lectures, and urges that the essential feature of all teaching should be "problem-solving" in some form or other. This method, he suggests, is fully developed in the teaching of languages, in which "the grammar furnishes the laws and general principles, together with all the known exceptions," "the dictionary supplies the isolated facts," and "the text provides the subject of study in constant and definite form." In the case of chemistry, he urges a closely interwoven scheme of laboratory work and class-room discussion, supplemented (if lectures are used) by briefly written answers to set questions and home study in varying amounts to suit the necessities of the individual student.

THE annual general meeting of the Association of Headmasters was held in London on January 12 and 13. Mr. Philip Wood, headmaster of Darlington Grammar School, the president for the year, in his presidential address referred to the question of the provision of free places in secondary schools receiving grants from the Board of Education. He said there are many grammar schools in towns with a population of less than 20,000 which educate the sons of the professional people and better-class tradesmen, but depend largely for their existence on being able to attract boarders. The position of such a school at the present time is very precarious. It has had always something of a struggle, and the grants of local education authorities and of the Board of Education are just what it requires to give it new life; but the grants are conditioned, and the conditions, at least of the Board of Education, would seem to contemplate a large day school in a large town rather than the kind of school in question. In a small market town, for instance, it is ridiculous that a school of, perhaps, seventy-five boys should be increased to 100 in order to provide for the education of twenty-five boys from the two or three elementary schools in the town. Boys capable of taking advantage of these opportunities are not to be found; and what is also a matter of common experience, their admission, whether they are capable or incapable, generally means the displacement of an equal number of boys whose parents do not like the new situation. Thus the 25 per cent. rule, which does not greatly embarrass a large day school, will, if rigorously applied, almost ruin many schools which we can ill afford to lose.

THE Department of Agriculture and Technical Instruction for Ireland has issued a pamphlet giving an account, by Mr. George Fletcher, assistant secretary for technical instruction, of the summer courses of instruction for teachers instituted by the Department in 1901. The courses are held in July and August, and extend over a period of about a month. They are held in Dublin and elsewhere. In selecting teachers to attend the courses, regard is had to the qualifications of the teachers and the needs of the school or district from which they come. After each year's course, teachers who pass the examinations are provisionally recognised as qualified to teach the subjects in which they have passed. Courses are held in experimental science, drawing, manual work in wood, and domestic economy. Besides preparing teachers to conduct classes in the Department's "Programme for Day Secondary Schools," the summer courses are year by year coming to serve a further purpose. Side by side with the development of the Department's scheme in day secondary schools there has grown up a system of specialised technical education all over Ireland. The rate of growth has been rapid, and a large and increasing number of Irish teachers are engaged in the schools and classes organised through urban and county councils. While it was necessary in the initial stages of such a system to employ teachers having experience of similar work, from whatever source they might be obtained, special efforts have since been made to train Irishmen when and where possible. Hence it is that year by year an increasing number of summer courses are organised to deal with subjects purely technical in character and having for their object the further education and training of teachers already engaged in Irish technical schools. It would be difficult to over-estimate the value of these courses as an element of educational progress. The typical courses described in the pamphlet by means of syllabuses, descriptions, and illustrations indicate what great pains have been taken by the authorities to make the lectures and practical work meet the needs of the teachers exactly.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 13.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir Edward **Thorpe** and A. G. **Francis**: The atomic weight of strontium.—L. F. **Richardson**: The approximate arithmetical solution by finite differences of physical problems involving differential equations, with an application to the stresses in a masonry dam. In order to deal with irregular boundaries, analysis is replaced by arithmetic, continuous functions are represented by tables of numbers, differentials by central differences. Then problems fall into two classes. (A) The relation between the equation obtaining throughout the body and the boundary condition is such that the integral can be stepped out from a boundary. This class includes equations of all orders and degrees. It has been treated by arithmetical differences by Runge, W. F. Sheppard, Karl Heun, W. Kutta, and Richard Ganz. Examples of a specially simple method are given. (B) The integral must be determined with reference to the boundary as a whole, as in Dirichlet's problem. The method given has only been worked out for a limited group of linear equations, namely, for those in connection with which a function analogous to potential energy exists, which is a complete minimum when and only when the difference equations are satisfied. Under this condition the difference between the integral ϕ_u and a function ϕ_1 of the independents, having the correct boundary conditions but otherwise arbitrary, can be expanded in the form $\phi_1 - \phi_u = \Sigma A_k P_k$ where the A_1s . . . A_n are constants and P_1 . . . P_n are "principal modes of oscillation" defined by $\mathbf{D}'P_k = \lambda_k{}^2 P_k$ where $\mathbf{D}'\phi_u = 0$ is the difference equation to be integrated and λ^2 is a constant. Now we start with the table of numbers ϕ_1 and calculate $\mathbf{D}'\phi_1$. Then as $\mathbf{D}'\phi_u = 0$ we have $\mathbf{D}'\phi_1 = \mathbf{D}'(\phi_1 - \phi_u) = \Sigma A_k \lambda_k{}^2 P_k$. Multiplying both sides by some number $\alpha_1{}^{-1}$ and subtracting from ϕ_1, and altering the boundary numbers so that the boundary condition is still satisfied, we have a new table which may be called ϕ_2; and $\phi_2 - \phi_u = \Sigma A_k(1 - \alpha_1{}^{-1}\lambda_k{}^2)P_k$. Repeating the process with $\alpha_2 \ldots \alpha_m$ we get:

$$\phi_{m+1} - \phi_u = \Sigma A_k(1 - \alpha_2{}^{-1}\lambda_k{}^2)(1 - \alpha_2{}^{-1}\lambda_k{}^2) \ldots (1 - \alpha_m{}^{-1}\lambda_k{}^2)P_k.$$

Now a function I exists such that $\mathbf{S}IP_k{}^2 = 1$, $\mathbf{S}IP_l P_k = 0$ where **S** denotes a summation throughout the region. Therefore:

$$\mathbf{S}I(\phi_{m+1} - \phi_u)^2 = \Sigma[A_k(1 - \alpha_1{}^{-1}\lambda_k{}^2) \ldots (1 - \alpha_m{}^{-1}\lambda_k{}^2)]^2.$$

Now by a sufficient number of suitably chosen αs the polynomial in λ^2 on the right can be made small throughout the range from $\lambda_1{}^2$ to $\lambda_n{}^2$. Therefore the error of ϕ_{m+1} can be made small; for, since I is one signed it is measured by the L.H.S. The process is arithmetical. The error due to finite central differences is of the form

$$e_2 h^2 + e_4 h^4 + e_6 h^6 + \text{ \&c.},$$

where h is the coordinate difference and the *es* are functions of position independent of h. If the integral has been found for two or more sizes of h, more exact values of it can be extrapolated by this formula. These methods have been applied in the paper to calculate the stress-function in a masonry dam.—A. O. **Rankine**: A method of determining the viscosity of gases, especially those available only in small quantities.—Dr. P. **Phillips**: Recombination of ions at different temperatures.—Dr. G. C. **Simpson**: The electricity of rain and snow. This paper relates to measurements of the electricity of rain made in continuation of those described at the beginning of last year (Phil. Trans., Series A, vol. ccix., pp. 379–413, 1909), and, in addition, to a series of measurements of the electricity of snow made during the winter 1908–9. All the main conclusions drawn from the previous work have been confirmed, and it may now be stated with confidence that in Simla (*a*) more than three times as much positive as negative electricity is brought down by the rain; (*b*) the heavier the rainfall, the more likely is it to be positively charged; (*c*) light rain is, as a rule, more highly charged than heavy rain, irrespective of whether the charge is positive or negative. With regard to the electrification of snow, the measurements indicate that in Simla (*d*) the positive charge carried down by the snow is between three and four times as great as the negative charge; (*e*) snow is generally more highly charged than rain.—L. **Vegard**: The polarisation of X-rays compared with their power of exciting high-velocity kathode rays.

Mathematical Society, January 13.—Sir W. D. Niven, president, in the chair.—Dr. H. F. **Baker**: (1) The theory of the cubic surface; (2) an example of the expansion of a function in a series of polynomials.—G. N. **Watson**: The harmonic functions associated with the parabolic cylinder.—Dr. H. de S. **Pittard**: Note on the theory of sets in probabilities.—H. **Bateman**: The transformations of coordinates which can be used to transform one physical problem into another.—G. H. **Hardy**: Note on a former paper on the theory of divergent series.—Dr. W. H. **Young**: Homogeneous oscillation of successions of functions.—Dr. W. H. **Young** and Mrs. G. C. **Young**: The determination of a semi-continuous function from a countable set of values.—J. E. **Campbell**: Cyclic congruences.

Royal Astronomical Society, January 14.—Sir David Gill, K.C.B., president, in the chair.—J. **Evershed**: Radial movement in sun-spots: second paper. The paper contained further investigations on the spectra of sun-spots, made at the Kodaikánal Observatory, India. The spectra of every considerable spot had been photographed, and it was invariably found that, except when the spot was near the centre of the disc, the lines crossing the spot were inclined towards the red on the side nearest the limb, and towards the violet on the side nearest the centre of the disc. Assuming this inclination to be due to motion in the line of sight, the conclusion seemed inevitable that spots are centres of a force directed outwards in a horizontal plane. This would explain the motion of recession on the side nearest the limb, and of approach on the side nearest the centre of the disc. The effect would not be observed in the case of a spot near the central meridian, where there would be no motion in the line of sight. A study of the calcium lines showed a motion in the opposite direction (towards the centre of the spot), indicating an in-draught of calcium vapour in the higher chromosphere. No evidence was obtained of an upward current over spots, but there were some indications of downward movements. There are also indications of cyclonic motion, but in the opposite direction to that shown in some of Prof. Hale's spectroheliographs.—A. C. D. **Crommelin**: Diagram illustrating a method of charting the geocentric places of a comet referred to a fixed radius vector.—R. W. **Wood**: The moon in ultra-violet light; spectro-selenography. The author recommended a spectroscopic method of investigating the nature of the surface of the moon.

Institute of Metals, January 18.—Sir William H. White, K.C.B., F.R.S., president, in the chair.—G. D. **Bengough** and B. P. **Hill**: The properties and constitution of copper-arsenic alloys. One of the principal objects of the paper was to bring forward data for an authoritative pronouncement upon the best proportion of arsenic to be used to secure copper alloys having greater strength and rigidity, and greater resistance to the corrosive action of gases at high temperatures, than commercially pure copper. The first portion of the paper dealt with the mechanical properties of the alloys of industrial importance, and the second with their chemical composition. In the latter section the authors denied the existence of the compound Cu^2As, proposed by Hiorns, and confirmed the existence of the compounds Cu_3As and Cu_5As_2, already proposed by Friedrich.—E. A. **Smith**: The assay of industrial gold alloys. The author gave a brief comparative description of the methods in general use for the assay of industrial gold alloys, based on experimental work carried out at the Royal School of Mines and in the University of Sheffield. It was shown that the results for gold assay were invariably higher when determined by direct cupellation with parting silver than when determined indirectly by double cupellation.—Dr. R. **Seligman** and F. J. **Willott**: The analysis of aluminium and its alloys. A detailed description was given of the technical methods of estimating the various foreign elements (copper, zinc, nickel, magnesium, tin, lead, manganese, titanium) and impurities (silicon, iron, and sodium) to be found in commercial aluminium and aluminium alloys. It was pointed out that the effect of these elements, particularly in minute proportions, upon aluminium was but little understood, and that it was desirable that research be directed along those lines.

EDINBURGH.

Royal Society, December 20, 1909.—Sir William Turner, K.C.B., president, in the chair.—Sir William **Turner**: The aborigines of Tasmania, part ii., the skeleton. The paper gave further particulars as to the specimens of Tasmanian skulls and skeletons now extant, and described in detail the bone anatomy of the specimen in the museum at Brussels. The discussion emphasised the fact that the Tasmanian had differed in important particulars from the ordinary black races, but resembled them in other respects. As regards the flattened femurs, the Tasmanian suggested affinity with the cave-dwellers and the Maoris, whereas in the form of the pelvis there was greater resemblance to the European races.—W. T. **Gordon**: The structure and affinities of *Zygopteris Römeri* (Solms). The petiole of this form was described by Solms Laubach from the Culm of Falkenberg. A few years later a similar petiole was obtained by Renault from rocks in Autun, and called *Diplolabis Esnostensis*. The present specimens of stems, petioles, and roots were found last year by the author in rocks of Calciferous Sandstone age at Pettycur, in Fife. The stem is protostelic, and is circular in transverse section. The wood consists of an inner zone with short elements, and an outer zone with longer tracheides. All the wood elements, whether long or short, have reticulate thickenings in their walls. The stem branches dichotomously. Appendages are given off from the stem at long intervals. These are either petioles or roots. At successive levels in the petiole the trace is indistinguishable from the characteristic trace in several different genera. *Zygopteris Römeri* is thus a synthetic type so far as the stages in the development of its petiole are concerned, and in the possession of a protostele the plant is the most primitive zygopterid yet discovered. In its organisation it has an important bearing on the origin of the Botryopteridæ and the Osmundaceæ.—Prof. Gwynne **Vaughan** and Dr. R. **Kidston**, F.R.S.: The fossil Osmundaceæ, part iv., and conclusion. Two new species are described, *Osmundite Kolbei* and *O. Schemniciensis*. The latter is closely similar to the modern Osmunda, but the anatomy of the former is described for the first time. It is very interesting owing to the position it takes up between the Osmundaceæ that have a solid xylemed stele and those with a broken ring of xylem surrounding a pith. The xylem is broken up into separate strands, but its pith contains scattered groups of tracheal elements. The general results of the whole paper are summed up, and the relationships between the Osmundaceæ and the Zygopterideæ are discussed in some detail, especially with reference to the peculiarities of the structure of the zygopterid leaf-trace.—Prof. J. C. **Ewart**, F.R.S.: The restoration of an ancient race of horse. About the middle of last century Owen received two upper molar teeth of a small member of the Equidæ family from a cavernous fissure at Oreston, near Plymouth. Similar teeth were obtained from the drift lying over the London at Chatham and from Kesingland, in Suffolk. Owen realised that these molars could not belong to a small variety of *Equus fossilis*—the species now represented by the wild horse (*E. przewalskii*) of Mongolia—but he had some difficulty in deciding whether they were the teeth of a small race of horses or the teeth of an ass or a zebra. Eventually he concluded that the Oreston teeth belonged to a "wild ass or quagga," which, with a wild horse and a wild boar, entered "into the series of British Pliocene hoofed mammals." To this fossil wild ass or zebra Owen gave the name of *Asinus fossilis*. In addition to the last two upper molars there is preserved in the British Museum a first upper molar from Oreston which probably belonged to an animal between ten and eleven hands at the withers. In this small first molar the grinding surface of the "internal pillar"—a fold of enamel on the inner surface of the tooth—is only one-third the length of the grinding surface of the crown. In having a small internal pillar or protocone in this first upper molar, the Oreston type differs profoundly from the wild horse of Mongolia, but resembles (1) the small horses which at the beginning of the Pliocene period lived in Nebraska, *i.e.* horses of the Pliohippus group; (2) a small race which towards the close of the Pliocene frequented the valley of the Arno—a race hitherto included in the *E. stenosis* group; (3) a small variety which in Pliocene times lived in Auvergne and other parts of France, sometimes known as *E. ligeris*; and (4) a small equine which in Pleistocene times occurred in Algiers, to which M. Thomas gave the name *E. asinus atlanticus*. M. Boule regarded the last two as closely related, and as probably the direct ancestors of the zebras now living in South Africa. The Italian, French, and English deposits have also yielded cannon bones—metacarpals and metatarsals—as slender as those of the fine-boned desert Arabs, but not so slender as the cannon bones of the Onager and other wild asses of Asia. From inquiries extending over some years, Prof. Ewart had ascertained that there were small horses in the Roman Fort at Newstead, near Melrose, with molars of the same type as those from Oreston, and with cannon bones as slender as the fossil ones from the Valley of the Arno, Auvergne, and Kent's Cave, Torquay. Further, in a six-year-old Shetland pony of the Celtic type he had recently noticed that the first upper molars, in size as well as in the enamel foldings, were practically identical with the small first Oreston molar in the British Museum. He was of the opinion that the teeth said by Owen to belong to a fossil ass or zebra really belonged to a small race of horse, from which have in part descended the modern Exmoor, Welsh, Shetland, and other ponies of the Celtic type. To this small, true horse, which in Pleistocene times probably ranged from Algiers to the south of England, he had given the name *Equus agilis*—the more appropriate name *gracilis* not being available. Bearing in mind that several of the zebra hybrids which he had bred some years ago seemed, at least in their markings, to reproduce ancestral types, he decided to try to restore the small race which lived in the south of England along with the mammoth. By blending all the available Occidental and Oriental breeds, Prof. Ewart had now obtained several ponies which probably in make, disposition, and colour, as well as in limbs and teeth, fairly accurately reproduced the small, slender-limbed species hunted and sketched or sculptured by our Palæolithic ancestors. The pony which probably restores most accurately the small, fine-boned prehistoric race has a fine head, slender limbs and small hoofs, a mane which instead of clinging to the neck arches to one side, a well set-on tail, and only two of the eight callosities usually found in horses, *i.e.* the four ergots and the hind chestnuts are absent. This pony, like the other forty crosses bred, cannot be described as "more or less striped"—there is only a narrow dorsal band and a faint shoulder stripe—and hence lends no support to the view that in prehistoric times all the wild horses were at least as richly decorated as the recently extinguished quagga, or to M. Boule's view that the small horse which in Pleistocene times inhabited the south of France and North Africa is the direct ancestor of the zebras now living in South Africa. Though this hybrid pony is, like the wild horse of Mongolia, of a yellow dun colour, and is a mixture of seven more or less well-marked breeds, namely, Connemara, Welsh, Hackney, Iceland, Hebridean, Shetland, and Arab, it excels in make, action, and intelligence all the other ponies of a like age—an indication perhaps that, notwithstanding its mixed origin, it possesses the traits of an ancient wild race.

PARIS.

Academy of Sciences, January 10.—M. Émile Picard in the chair.—H. **Deslandres**: The magnetic storm of September 25, 1909, and the connected solar phenomena. A verification of some theories proposed. A discussion of the various theories of the influence of the sun on the earth. The author regards the theory of kathode radiation put forward by himself and by Birkeland as offering a sufficient explanation of the observed facts. It explains the delay of forty-five hours of the magnetic storm with respect to the passage of the active spot across the central meridian, and is connected with the author's theory of nebulæ.—J. **Carpentier**: Remarks on a frequency meter constructed from the designs of Commandant Ferrié, and also on a small precision balance constructed by M. Collot. The weights, from 50 grams to a decigram, are introduced on the pans by pressing buttons external to the balance case; the smaller weights are read by a microscope as deviations of the pointer. The balance works at constant load—100 grams—and by substitution, and is very rapid in its indications.—C. **Guichard**: The surfaces of total constant curvature which correspond to singular systems of any order.—C. **Russyan**: The theorem of W. Stekloff (the generalised theorem of Jacobi) and generalised formulæ of contact transformation.—Henri **Lebesgue**: The integral of Stieltjes and linear functional operations.—J. **Le Roux**: Definite quadratic forms with an infinity of variables.—E. **Jouguet**: The impossibility of certain waves of shock and combustion.—E. **Estanave**: Images changing from two or three points of view on the autostereoscopic plate.—Edm. **van Aubel**: The production of ozone under the influence of ultra-violet light. The production of ozone by the action of ultra-violet light, first observed by Lenard, has been confirmed by other observers. On the other hand, H. Bordier and T. Nogier have recently described experiments leading to the contrary conclusion. The experiments detailed in the present paper confirm Lenard's experiments.—F. **Ducelliez**: The study of some alloys of cobalt from the point of view of their electromotive forces. Curves are given for the experimental measurements with alloys of cobalt with tin, antimony, bismuth, lead, and copper.—A. **Besson** and L. **Fournier**: A new chloride of phosphorus. No chloride of phosphorus corresponding to the hydride P_2H_4 and the iodide P_2I_4 has hitherto been described. This chloride, P_2Cl_4, is produced by the action of the silent electric discharge on a mixture of hydrogen with the vapour of phosphorus trichloride. The new chloride forms a colourless, oily liquid, solidifying at $-28°$ C., and distilling with slight decomposition at 95° C. under a pressure of 20 mm. It absorbs oxygen rapidly from the air, and sometimes catches fire spontaneously. Attempts to isolate the corresponding bromide were unsuccessful.—Marcel **Delépine**: The solution of platinum in sulphuric acid, and on the products of this reaction. The presence of oxygen is not necessary to the reaction between platinum and sulphuric acid, as has been assumed by M. Quennessen, since solution takes place in a stream of carbon dioxide, air, oxygen, or carbon dioxide mixed with sulphur dioxide.—Pierre **Jolibois**: Two new phosphides of nickel. These compounds were obtained by heating a nickel-tin alloy in sealed tubes with phosphorus. The composition of the phosphides agreed with the formulæ NiP_2 and NiP_3.—E. **Cornec**: The formula of hypophosphoric acid. A cryoscopic study of aqueous solutions of the acid and the potassium salt. The double formula $H_4P_2O_6$ agrees best with the facts observed.—J. B. **Senderens**: The catalytic preparation of the aromatic ketones. The catalytic action of thoria at 460° C. upon a mixture of benzoic and a fatty acid gives a mixture of the symmetrical fatty ketone and the mixed fatty aromatic ketone, no benzophenone, apparently, being formed. The method has been successfully applied to the preparation of ketones of the general formula C_6H_5—CO—R, in which R was methyl, ethyl, normal and isopropyl, and isobutyl.—M. **Lespieau**: Methylacetenylcarbinol.—Em. **Bourquelot** and M. **Bridel**: The presence of gentiopicrin in *Chlora perfoliata*. Details are given of the methods employed for isolating this glucoside in the pure state.—H. **Bierry**: Researches on the digestion of inulin. It is found that various animals are capable of digesting inulin, but they employ for this digestion different physiological agents. In the higher animals, the transformation of the inulin takes place in the stomach, and is due to the hydrochloric acid of the gastric juice; in molluscs a ferment is secreted which is capable of hydrolysing the inulin to levulose.—J. **Sarthou**: The presence in cow's milk of a catalase and an anæroxydase. The statement of MM. Bordas and Touplain that the insoluble casein of milk is capable of decomposing hydrogen peroxide is denied, and experiments detailed which tend to show that this action is due to a mixture of a physiological catalase and a bacterial catalase.—Louis **Roule**: The structure of the epidermal protuberances of certain Amphibia and their morphological affinities with the nails. —J. **Nageotte**: A new formation of the myeline layer.—J. **Mawas**: The structure of the ganglion nerve cells of the amyelinic cord of the Cyclostomes.—A. **Contamin**: The immunisation against cancer of mice inoculated with tumours modified by the X-rays.—L. **Bull**: The mechanics of insect flight.—C. **Levaditi** and K. **Landsteiner**: Researches on experimental infantile paralysis. The preventive inoculation of animals by means of the dried spinal cord is possible.—A. **Thiroux** and W. **Dufougeré**: A new spirilla from *Cercopithecus patas*. This organism resembles in its morphological characters the *Spirillum duttoni* of tick fever, from which, however, it is distinct. The name *Spirillum pitheci* is proposed.—L. **Cayeux**: The prolongation of the Silurian oolitic iron deposits under the Paris basin.—E. **de Martonne**: The mechanical theory of glacial erosion.—Alfred **Angot**: The value of the magnetic elements at the Val-Joyeux Observatory on January 1, 1910.—E. **Esclangon**: The intensity of gravity and its anomalies at Bordeaux and neighbourhood.—E. **Péroux**: The mineral contents and chemical analysis of the water from the artesian wells of Maisons-Laffitte.—André **Brochet**: New determinations of the radio-activity of the thermal springs of Plombières. These springs are strongly radio-active, this effect being due to the radium emanation.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 20.

ROYAL SOCIETY, at 4.30.—Further Observations on the Pathology of Gastric Ulcer (Progress Report): Dr. C. Bolton.—(1) The Velocity of Reaction in the "Absorption" of Specific Agglutinins by Bacteria, and in the "Adsorption" of Agglutinins, Trypsins, and Sulphuric Acid by Animal Charcoal; (2) On the Absorption of Agglutinin by Bacteria, and the Application of Physico-chemical Laws thereto: Dr. Georges Dreyer and J. Sholto Douglas.—Observations on the Rate of Action of Drugs (Alcohol, Chloroform, Quinine, Aconitine) upon Muscle as a Function of Temperature: Dr. V. H. Veley, F.R.S., and Dr. A. D. Waller, F.R.S.—An Examination of the Physical and Physiological Properties of Tetrachlorethane and Trichlorethylene: Dr. V. H. Veley, F.R.S.—The Action of Antimony Compounds in Trypanosomiasis in Rats: J. D. Thomson and Prof. A. R. Cushny, F.R.S.—"Amakebe" (a Disease of Calves in Uganda): Colonel Sir David Bruce, F.R.S., Captains A. E. Hamerton and H. R. Bateman, R.A.M.C., and Capt. F. P. Mackie, I.M.S.—On Scandium: Sir William Crookes, For.Sec.R.S.

ROYAL INSTITUTION, at 3.—Assyriology: Rev. C. H. W. Johns.

LINNEAN SOCIETY, at 8.—Discussion on the Origin of Vertebrates: Dr. Gaskell, Dr. Gadow, Mr. Goodrich, Prof. Starling, Prof. MacBride, Dr. Smith Woodward, Prof. Dendy.

INSTITUTION OF MINING AND METALLURGY, at 8.—Copper Leaching Plant in the Ural Mountains: A. L. Simon (*Adjourned discussion.*)—Some Analyses of Copper Blast Furnace Slags and Determination of their Melting Points: A. T. French.—The Detection of Minute Traces of Gold in Country Rock: A. R. Andrew.—Errors due to the Presence of Potassium Iodide in testing Cyanide Solutions for Protective Alkalinity: B. Collingridge.

FRIDAY, JANUARY 21.

ROYAL INSTITUTION, at 9.—Light Reactions at Low Temperatures: Sir James Dewar, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Ninth Report to the Alloys Research Committee: On the Properties of some Alloys of Copper, Aluminium, and Manganese (with an Appendix on the Corrosion of Alloys of Copper and Aluminium when exposed to the Sea): Dr. W. Rosenhain and F. C. A. H. Lantsberry.

PHYSICAL SOCIETY, at 5.—Saturation Specific Heats, &c., with van der Waals' and Clausius' Characteristics: R. E. Baynes.—The Polarisation of Dielectrics in a Steady Field of Force: Prof. W. M. Thornton.—On the Use of Mutual Inductometers: Albert Campbell.

MONDAY, JANUARY 24.

ROYAL SOCIETY OF ARTS, at 8.—Textile Ornamentation: A. S. Cole.

VICTORIA INSTITUTE, at 4.30.—The Attitude of Science towards Miracles (being the Gunning Prize Essay, 1909): Prof. H. Langhorne Orchard.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Travels in Northern Arabia: D. Carruthers.

TUESDAY, JANUARY 25.

ROYAL INSTITUTION, at 3.—The Cultivation of the Sea: Prof. W. A. Herdman, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30—Annual General Meeting.—Presidential Address: The Influence of Environment on Man: Prof. W. Ridgeway.

MINERALOGICAL SOCIETY, at 5.30.—On a Group of Minerals formed by the Combustion of Pyritous Shales: S. J. Shand.—A Crystal-holder for Measuring Large Specimens: W. J. Lewis.—Some Observations on Pleochroism: T. Crook.—Notes on the Weight of the "Cullinan" Diamond and on the Value of the Carat-weight: L. J. Spencer.—On a Basalt from Rathjordan, Co. Limerick: G. T. Prior.—On a Fluo-arsenate from the Indian Manganese Deposits: G. F. H. Smith and G. T. Prior.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Reconstruction of the Tyne North Pier (*Discussion*): I. Collingwood Barling.

WEDNESDAY, JANUARY 26.

ROYAL SOCIETY OF ARTS, at 8.—Goldsmiths' and Silversmiths' Work: O. Ramsden.

GEOLOGICAL SOCIETY, at 8.—On a Skull of Megalosaurus from the Great Oolite of Munehinhampton: Dr. A. S. Woodward.—Problems of Ore-deposition in the Lead- and Zinc-veins of Great Britain: A. M. Finlayson.—On the Vertebrate Fauna found in the Cave-earth at Dog Holes, Warton Crag (Lancashire): J. W. Jackson.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, JANUARY 27.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Note on Carbon Monosulphide: Sir James Dewar, F.R.S., and Dr. H. O. Jones.—Long-period Determination of the Rate of Production of Helium from Radium: Sir James Dewar, F.R.S.—On the Extinction of Colour by Reduction of Luminosity: Sir William de W. Abney, K.C.B., F.R.S.—The Initial Accelerated Motion of Electrified Systems of Finite Extent, and the Reaction produced by the Resulting Radiation: George W. Walker.—On the Nature of the Magnetokathodic Rays: H. Thirkill.

ROYAL INSTITUTION, at 3.—Assyriology: Rev. C. H. W. Johns.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Equitable Charges for Tramway Supply: H. E. Yerbury.

FRIDAY, JANUARY 28.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Some Uses of Mechanical Power in Engineering Construction: H. F. Donaldson.

SATURDAY, JANUARY 29.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.—Trawl Fishing in the North Sea: S. H. Goodchild.

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THURSDAY, JANUARY 27, 1910.

AN AMERICAN AGRICULTURAL CYCLOPEDIA.

Cyclopedia of American Agriculture. A Popular Survey of Agricultural Conditions, Practices, and Ideals in the United States and Canada. Edited by L. H. Bailey. Vol. IV. Farm and Community. Pp. xiv+650. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 21s. net.

DR. BAILEY is surely the most energetic of the agricultural editors of to-day. Besides writing a dozen or more books himself, he has edited a long series of text-books, a great Cyclopedia of American Horticulture, and has now completed the companion Cyclopedia of American Agriculture. So much has he found this task to his liking that he tells us he

> "would like to make another. It is much satisfaction to assemble the opinions of the best men and women in a particular field, and to work them out into a harmonious arrangement."

The subject-matter is not set out under headings in alphabetical order, but is grouped in four great divisions; the first volume dealt with the laying out and organisation of a farm, the second with the crops, the third with the animal products, and in this fourth and last volume we come to

> "the larger question of the relation of the farmer to his fellow men, and of the farm to the other assets of the commonwealth."

This volume, reviewing as it does all those economic, social, and political aspects of rural life which are of never-failing interest, will therefore appeal to a much larger circle of readers than did the others. Most people will be surprised at the magnitude of agricultural industries in the United States. They employ more capital than do all the manufactures put together, and more than one-third of the entire working population, as compared with one-fourteenth in Great Britain. The agricultural exports are larger than any others, whilst the imports form nearly one-half the total imports. Maize is the most important crop, exceeding in annual value any other two combined; further, it is the largest single American product of any kind, agricultural, mineral, or manufactured. A considerable section of the volume is devoted to the history of North American agriculture from Indian times to the present day. Maize has always been the chief cultivated food plant. Jacques Cartier found large fields of it growing in 1534 where Montreal now stands. Champlain in 1604 found it cultivated almost everywhere from Nova Scotia to points far up the Ottawa river. Much was eaten green, generally after it had been roasted or boiled; indeed we may trace not a few of the characteristic American and Canadian dishes to an Indian origin. Beans, pumpkins, squashes, and tobacco were raised by the Indians; fruit was preserved in wild honey; sugar was made from the juice of the maple. An account of this operation can be found in the Philosophical Transactions of the Royal Society for 1684–5 (p. 156), while the Indian maize culture is described in the preceding volume, p. 466. This paper is, as usual, overlooked, probably because it was somehow omitted from the index to the volume. The Indians kept meat in cold storage, *i.e.* in snow, they cured tobacco by heat, they practised irrigation in the dry districts, they cultivated cotton, preserved fruit berries and vegetables by sun and air drying, and they preserved vegetables from rotting by burying them in the ground—the idea of the modern silo.

Coming to historic times, five main periods can be noticed. In the colonial period, 1607–1783, the settlers were adapting and improving on the Indian methods. Next follows the time of the western expansion. From 1830 an enormous change arose in consequence of the introduction of railroads, the repeal of the English corn laws, and the wars and other events in Europe which created a demand for American food products. Lastly, American agriculture has been largely reorganised since 1887, when the Experiment Station Act (Hatch Act) was passed by Congress. Since this time there has been developed that wonderful system of experiment stations and agricultural colleges that is without equal in the whole world. Irrigation and drainage are also attracting attention. It is estimated that there are still eighty million acres of swamp land, not only practically valueless, but a hindrance to travel and a menace to health, which, if properly drained and cultivated, could probably support a population of 10,000,000 people. Various chapters in these historic movements are worked out in considerable detail; we have, for instance, what has probably never been attempted before, a chapter on historic farm animals. Much space is devoted to the present position of agriculture. Various means of checking the rural exodus are suggested, among others that the country schools should teach the love of country life and train for life in the country. Mr. Booker Washington brings out the interesting point that while negroes constitute less than one-twelfth of the population of the United States, they conduct 13 per cent. of the farms, and raise 5·4 per cent. of the total farm products.

Natural resources, especially forestry, receive a good deal of attention. It is shown, too, that the agricultural labourer is very efficient; 9,000,000 hands in the United States raise nearly half as much grain as 66,000,000 in Europe, where, however, far fewer horses are employed. Business organisation, book-keeping, costs, cooperation, and credit are next discussed, while a section is given to the amenities of rural life, the church, travelling libraries and travelling pictures, social organisations, the rural landscape, and "the farm beautiful."

Dr. Bailey himself writes on agricultural education. We notice that the American colleges are subjected to criticism just as are our own, because many of their best students do not become farmers. The answer is, of course, obvious; they are needed to provide the enormous staff of experts maintained by the colleges and experiment stations. The American educational system is more complete than ours in that it aims at giving systematic instruction to the men actually farming. The means adopted include courses at the colleges, reading circles at home, and farmers' institutes. Full details of the working of these schemes are given.

Legislature relating to agriculture is then dealt with, and the somewhat varying laws of the different States are summarised. Lastly, we have a number of biographies of persons who were prominent in developing "agriculture and wholesome country living, and in starting new movements of national consequence."

The volume can be cordially recommended to all who are interested in the remarkable progress of agriculture in the United States. The story is wonderfully interesting, even when told in the rather disjointed manner that is a necessary consequence of a number of authors and an encyclopædia. Problems are arising in parts of the British Empire not unlike those that have arisen in the United States. The methods by which they were dealt with there, which are so well set out in the present volume, cannot fail to afford valuable and suggestive material to agricultural workers and administrators elsewhere.

E. J. RUSSELL.

SIR JOSEPH BANKS.

Sir Joseph Banks, the "Father of Australia." By J. H. Maiden. Pp. xxiv+244. (Sydney: William Applegate Gullick; London: Kegan Paul and Co., Ltd., 1909.) Price 6*s.* net.

IN an old gazetteer we read that Botany Bay was discovered in 1770 by Captain Cook, who so named it from the great quantity of herbs which he found on its shores. This statement is true, of course, as to the main fact, but it is otherwise inaccurate and incomplete, for no doubt the name was suggested by Sir Joseph Banks's report on the vegetation of the country around their first landing-place in Australia and the very rich botanical collections obtained. After circumnavigating New Zealand the question arose whether the *Endeavour* should sail in search of the supposed southern continent or make for the coast of New Holland, and the latter course was determined upon because the condition of the ship was not considered equal to encounter the stormy southern seas. The expedition arrived in the bay on April 28 and left on May 6, and an entry in Banks's journal, dated May 3, runs as follows:

> "Our collection of plants was now grown so immensely large that it was necessary that some extraordinary care should be taken of them lest they should spoil in the books."

This note referred to the collections previously made in New Zealand, as well as the Australian plants, of which, by the way, only a small proportion were herbs.

In commemoration of this notable and important event an obelisk was erected in 1870, the centenary of the landing of Cook and Banks, but it has long been felt in Sydney that Banks's services in the exploration and colonisation of Australia have not been adequately recognised. As Mr. Maiden states in the book before us:—"His journal of the voyage was made over to Hawkesworth, who so arranged the narrative that Banks did not receive due credit." The recent publication of Banks's journal, edited by the venerable Sir Joseph Hooker, has brought to light the prominent part Banks took in the expedition, and the publication now of a portion of his correspondence shows that he was more or less actively engaged during the remaining fifty years of his life in promoting the interests of the young colony and the exploration of the surrounding country. A committee has been constituted in Sydney to collect a fund for the purpose of providing a memorial to Banks. Mr. Maiden has joined the movement, and the book he now offers the public has been compiled with the double object of disseminating information concerning "Australia's greatest early friend" and of procuring a handsome contribution to the memorial fund. It has been printed at the expense of the State of New South Wales, and the whole of the proceeds of the sale will be devoted to the object in question.

That a botanist should have undertaken this task is appropriate, and a botanist living on the spot where Australia's colonisation began, because Banks himself, though a man of universal sympathies, was essentially a botanist and horticulturist. Mr. Maiden has not written a biography of Banks, though he chronicles the leading events of his whole career. Following this he has strung together a chronological narrative of events connected with the early history of Australia, in which many important personages figure besides Banks. The whole is a highly interesting record of facts, gleaned from a variety of sources and selected for the purpose of establishing, or rather vindicating, Banks's claim to the gratitude of both the old and the new countries for the leading part he took in what has proved a most momentous movement in the population of the Antipodes. The book is fully and suitably illustrated, including portraits, early views, and reproductions of Cook's charts of Botany Bay and the entrance to the Endeavour River, on which the modern Cooktown is situated. It is a book, too, that everybody interested in Australia should read, and thereby derive much pleasure, and directly or indirectly assist the author in his patriotic effort. Short extracts from two of Banks's characteristic letters, dated 1797 and 1799, and addressed to Governor Hunter, may close this notice:—

> "The climate and soil are in my opinion superior to most which have yet been settled by Europeans. . . . I see the future prospect of empire and dominion which now cannot be disappointed. Who knows but England may revive in New South Wales when it has sunk in Europe? Your colony is already a most valuable appendage to Great Britain, and I flatter myself we shall before it is long see her Ministers made sensible of its real value."

W. B. HEMSLEY.

THE ESSENTIALS OF THE COMPARATIVE ANATOMY OF VERTEBRATES.

Vergleichende Anatomie der Wirbeltiere. By Dr. Robert Wiedersheim. Siebente Auflage. Pp. xx+936; 476 text-figures, and one lithographic plate. (Jena: Gustav Fischer, 1909.) Price 21 marks.

THE seventh edition of this well-known text-book is much more than a mere reprint of the 1906 edition, the work in its present form having experienced both a thorough revision and a considerable increase in bulk. Additions have been made to the accounts of nearly every system of organs, and the verbal descriptions supplemented by the inclusion of nearly one hundred new text-figures. The new figures illustrating the skulls, so coloured as to distinguish bone from cartilage, are very effective, and those of Petromyzon, Lacerta, Crocodilus, and Chelone will be found especially useful; indeed, it is a pity that a few more laboratory types (such as Hatteria, and some additional birds and mammals) were not included at the same time. The valuable literature-list—a most excellent feature of this book—has also of necessity been much enlarged.

The account of the nervous system shows a marked advance on that of the earlier editions. The description of the internal structure of the brain embodies some of the important results obtained in recent years by Edinger, Sterzi, Elliot Smith, Johnston, and other workers in this branch of anatomy. There is also included a more thorough exposition of the modern component theory of the cranial nerves, though we are of opinion that the sections treating of this subject, and of the primitive segmentation of the head, might with advantage have been still more expanded, both as regards the facts and their theoretical interpretation. The questions, for example, as to the alleged serial homology between ordinary eyes and the paired pineal organs, the primitive sensory nature of the epibranchial placodes (referred to on p. 331) and their possible connection with the eye and the nose, the late origin and consequent non-homology of the acustico-lateral system of nerves with the spinal nerves, the secondary nature of the segmental arrangement of the lateral-line sense-organs, the curious situation of the supposed gustatory organs in the external skin of certain teleosts and their innervation by the visceral sensory lateralis accessorius nerve, are all of intense interest, and worthy of a brief discussion in a book dealing with the fundamentals of vertebrate morphology. The chief results of the large amount of work recently pursued in connection with the gas-bladder of fishes have also been incorporated in the revised account of this subject, though we cannot agree with the unhesitating adoption of the Reis-Nüsbaum idea that the gas contents of the bladder are the product of the chemical decomposition of the substance of the gland-cells; in our opinion Jaeger's view, that the oxygen and other gases are derived directly from the blood and are merely pumped into the bladder cavity by the gland-cells, seems much more feasible. Among other sections of the book which have been considerably altered and extended are those relating to the morphology of the sternal skeleton, the phylogeny of the limb skeleton, the structure of the mammalian lung, the urinogenital apparatus of bony fish, and the male copulatory organs of the chief vertebrate groups.

Concerning what we venture to consider omissions in the book, we must confess that we should like to have seen, among other things, a complete account of the recent work of Osborn, Broom, and others on the Theriodont reptiles, and of the origin of the Mammalia from this ancient group, a subject of intense interest to comparative anatomists and one which has now been worked out in such complete detail that we can trace in these fossil reptilian skeletons the evolution of almost every bone in the mammalian skeleton. Again, the subject of the minute structure of fish-scales, to which Goodrich has recently directed attention, is quite untouched in the present work, though the facts are most striking, both from the standpoints of pure morphology and classification. In saying that these subjects are omissions, and thereby implying that in our opinion they should have been included, we are not unmindful that the size of the book must be kept within reasonable limits; we would only suggest that succinct accounts of the subjects just named and those before referred to are far more suitable for inclusion than descriptions and figures, *e.g.* of the external form of the ear, of the development of the cement organ of Polypterus, of the layers of the retina, and other similar topics which, though also worthy of mention, are of relatively less moment.

We may point out in conclusion that to the best of our belief the common text-book statement (p. 642) that the at-first paired umbilical (allantoic or hypogastric) veins are homologous with the epigastric veins of Amphibia and the lateral veins of Elasmobranchs has been disproved by Beddard: the two sets of veins are quite distinct.

A standard book like the present, and especially this last superb edition, is in no need of recommendation, and our recognition of this is a sufficient apology for the large proportion of criticism contained in the preceding remarks.

W. N. F. W.

THREE TEXT-BOOKS OF PRACTICAL CHEMISTRY.

(1) *A Course of Practical Chemistry Suitable for Public Schools.* By A. Beresford Ryley. Pp. viii+156. (London: J. and A. Churchill, 1909.) Price 4*s.* 6*d.* net.

(2) *Introduction to Practical Chemistry, for Medical, Dental, and General Students.* By A. M. Kellas. Pp. viii+262. (London: Henry Frowde, and Hodder and Stoughton, 1909.) Price 3*s.* 6*d.* net.

(3) *First Stage Inorganic Chemistry* (*Practical*). For the First Stage Examination of the Board of Education (South Kensington). Revised Edition. By H. W. Bausor. Pp. iii+85. (London: W. B. Clive, University Tutorial Press, Ltd., 1909.) Price 1*s.*

AS a general rule, the teacher of practical chemistry yields sooner or later to the apparently irresistible temptation of writing a text-book for the use of students attending his classes. The consequent excessive multiplication of elementary treatises is, in the main, deplorable, although the contents of some of these publications afford an interesting indication of the trend of contemporaneous science teaching.

(1) The course of practical chemistry suitable for public schools is of special significance from this point of view, inasmuch as the author refers to his procedure as a retrogression from the heuristic method, a system which he dismisses as "ideal, but quite impracticable in the larger classes of public schools." This course

of instruction begins with a series of introductory exercises on such fundamental principles as the nature of physical and chemical changes, the common elements and some of their typical compounds, and the processes of combustion, oxidation, reduction, &c. Detailed explanations are to be supplied by the demonstrator, who is also supposed to carry out the more difficult experiments, and to devise the simple apparatus required by the student.

Simple volumetric analysis is introduced at an early stage, but, unfortunately, the underlying principle of equivalence is not adequately explained. Two definitions of equivalent weight are given on p. 54, one referring to acids, and the other to bases and salts. In the latter, equivalent weight is stated to be the molecular weight divided by the sum of the valencies of the metallic radicle. This definition is not applicable to potassium permanganate, an important reagent generally introduced into an elementary course of volumetric analysis. The working instructions for the volumetric analysis and for the determination of equivalents and atomic weights are excellent, and make for neatness and accuracy in quantitative exercises. There are a few singular omissions in the general practical course; formic acid is not indicated as a source of pure carbon monoxide, and although the interaction of copper and hot concentrated sulphuric acid is mentioned thrice, on pp. 13, 92, and 98, no reference is made to the cuprous sulphide which is produced as a bye-product together with copper sulphate.

The last chapter is devoted to qualitative analysis, and contains the practical details of the dry and wet tests for the commonly occurring metals and acids, without equations or other theoretical explanations.

Although an experienced teacher could select, from the large number of practical exercises contained in this treatise, a typical set suitable for an elementary course, yet it would certainly be necessary to add a few simple gravimetric processes such as the estimation of iron, copper, chlorine, or sulphate. Otherwise, the student's practical experience would be sadly lacking in balance, for while having had an opportunity of attempting the preparation of comparatively uncommon compounds, such as phosphine and periodic and bromic acids, he might remain ignorant of the methods of elementary gravimetric analysis.

(2) The author of the second volume under review is of opinion that an elementary practical book should contain more complete explanations than are generally given. This course also begins with the practical study of the non-metallic elements and their typical compounds, but some of this introductory work may be omitted by students who have an opportunity of seeing these experiments demonstrated on the lecture table. The work on the non-metals is followed by the preparation of typical compounds of the metals. These exercises are of special interest to medical and dental students, as a knowledge of the preparations given in detail is required by the syllabus of the Conjoint Board. The list of preparations would be considerably improved by the inclusion of a few double salts (such as ferrous ammonium sulphate and the alums), some of which are quite suitable for an elementary course. The qualitative tests for the metals and acids are described in considerable detail, equations being given for the more important chemical changes, together with a summary relating to each metal and its notable compounds. Although this part of the book is fairly comprehensive, the tests for nickel and cobalt and for boric and hydrofluoric acids are omitted. In other respects, the qualitative analysis is quite adequately treated in a systematic manner, and the tables are remarkably free from errors. On p. 94 the interaction of a silver salt and sodium hydroxide gives the oxide Ag_2O, whereas on p. 148 the product is said to be the hydroxide AgOH. The first reaction on p. 112 refers to stannous sulphide.

The last chapter contains a brief introduction to quantitative analysis, dealing chiefly with volumetric processes.

(3) The third of the foregoing books has been re-written to meet the present requirements of the Board of Education as regards the elementary stage of practical inorganic chemistry. A description of the properties of some common substances leads up to elementary experiments consisting of observational work and simple quantitative exercises. Full working details are given as well as theoretical explanations. The book is admirably suited to the work of the elementary stage.

G. T. M.

OUR BOOK SHELF.

Bathy-orographical Wall Maps of the Pacific, Atlantic and Indian Oceans. (Edinburgh and London: W. and A. K. Johnston, Ltd.) Price 12s. each.

THESE maps of the oceans are on Mollweide's equal-area projection. The elevations and depressions shown are at 6000, 1500, 600 feet, and below sea-level on the land, while 100, 1000, 2000, 3000, and 4000 fathoms are represented over the sea area.

The elevations shown on the land are scarcely sufficient for the purpose for which these maps are undoubtedly intended, the study of the build of continents, but the sea depths should render them useful to teachers.

Many points are admirably illustrated. The oceanic islands are well shown as the culminating summits of ridges, and the use of such maps should help to correct the erroneous notions often prevalent as to the position of island groups.

The complicated series of islands in the Pacific Ocean can only be understood by reference to a clear ocean map. For example, the islands known as Melanesia, which rest on the submarine plateau to the east of Australia, can be seen to have an intimate connection with the mainland, with which they were once connected. On the outer fringe of these islands are the Solomon Islands and New Hebrides, and the Mikronesian group from the Caroline Islands to the Tonga Islands.

Further to the east the South Pacific chain suggests a possible land connection in former ages between South America and Australia, which may account for the migration of marsupial and land tortoises from one coast to the other.

The fringing chains of islands which extend on the north-west of the Pacific from Formosa to Alaska are admirably shown on this map, in contrast to the deep depressions known as the Tuscarora and Aleutian trenches.

The usual classification of the major submarine forms includes the shelf, the depression, and the elevation. The shelf extends to about 100 fathoms below sea-level. As the lowest ground represented in these maps, from 0 to 600 feet, is coloured green, while the sea to the depth of 100 fathoms is tinted a light blue, students will probably find it somewhat difficult to compare these areas. The maps would have gained considerably if both these regions, from 600 feet to the 100-fathom line, had been left white, and if the names, at any rate on the land, had been omitted. It is surely quite unnecessary to print "Africa" across the continent in such large letters as to obscure some of the details of the plateau of Abyssinia.

On the oceans the names are fewer in number, and do not interfere with the graphic effect of the deeper blue which marks the depressions and elevations of the ocean floor.

Though, as regards graphic representation, more suited for reference than school use, these maps have one important advantage. The equal-area projection employed is most effective for the oceans, when shown separately, and the comparison of areas possible should be useful in the study of the relative extent of land and sea.

The Practical Management of Sewage Disposal Works. By W. C. Easdale. Pp. 60. (London: The Sanitary Publishing Co., Ltd., 1909.) Price 2s. net.

The author has endeavoured with considerable success to deal, in the space of fifty-four small pages, with the more important points arising in the management of small sewage works and private-house installations, &c.

When considering the question of tanks, the author rather unfortunately states that in all types of tanks, *i.e.* sedimentation, precipitation, and septic tanks, the work to be done is the same, viz. the removal of suspended matter. This expression is somewhat misleading and liable to misinterpretation.

Apparently, in dealing with the removal of sludge from tanks, septic tanks only are considered, as the author's doctrine of "little and often" removal, without emptying the tank, can only in general be properly applied to such tanks, and, it may be added, only when the design of the tank allows of the removal of the more or less thoroughly septicised sludge. In the case of sedimentation and chemical precipitation tanks, it is almost essential that the sludge should be completely removed at each operation in order to avoid fermentation taking place, with its consequent ill-effect on the complete settlement of the suspended solids.

In connection with the design of contact beds, the author rightly directs attention to the extreme importance of the thorough and complete drainage of the bed, and also to the question of the size of the unit.

It is evident that there is a limit to the application of the maxim "little and often" advocated in regard to the removal of accumulated suspended matter from the surface of the contact beds. From the point of view of economy, cleansing operations should not be carried out too frequently, as it is obvious that a certain amount of filtering media must be removed at each operation, incurring additional cost; while so long as the accumulated suspended matter is not sufficient to impede the drainage from the surface and consequent ingress of air, no detrimental results may be anticipated.

The author's remarks with regard to the attention to be given to distributing apparatus in connection with percolating filters are important, and should be carefully noted. In connection with the final chapter on tests and records, Spitta's methylene blue test might with advantage be included, and possibly a colour test for nitrates.

The book can be thoroughly recommended for the objects defined in the author's introductory remarks.

E. A.

Das Reich der Wolken und Niederschläge. By Prof. Dr. Carl Kassner. Pp. 160. (Leipzig: Quelle and Meyer, 1909.) Price 1.25 marks.

This work, No. 68 of the popular scientific manuals published by Messrs. Quelle and Meyer, is to some extent the outcome of lectures delivered by the author at technical high schools, modified to meet the requirements of general readers. In addition to sound elementary information on the taking and reduction of observations, it includes the results of the most recent investigations, of the fundamental researches of Hann, Hellmann, and others, and useful references to the historical development of this branch of meteorological science. Chapters i.–v. treat of aqueous vapour, condensation, formation of fog and clouds, sunshine and cloudiness. Chapters vi.–x. deal with rainfall, snow and hail, exposure of gauges, calculation of results, &c. The remaining chapters, xi.–xiii., refer to the rainfall over the globe, the causes of its unequal distribution, to daily, yearly, and secular periods. The whole will repay careful perusal; among some of the many points of special interest we may note references to Goethe's appreciation of Howard's classification of clouds, to various kinds of glazed frost and hail, and to the effect of wind and exposure on rainfall records. Hellmann's classification and reproduction of Neuhauss's photographs of snow crystals are preferred to Glaisher's drawings, which the author hints should now be omitted from text-books. On p. 78 we notice that Chepstow is misprinted as Chepston.

Astronomische Abhandlungen der Hamburg Sternwarte in Bergedorf. Edited by the director, Dr. R. Schorr. Band i. No. 1, pp. 130, and 3 plates; No. 2, pp. 10, and 3 plates; No. 3, pp. 99. (Hamburg, 1909.)

Founded in 1825 by State-aided private means, the Hamburg Observatory was taken over by the State in 1833, and in 1906 was by decree transferred to the new site at Bergedorf. This site and its equipment are briefly described in Dr. Schorr's introduction to the new series of "Abhandlungen" of which that under review is the first volume.

Part i. is by Dr. Dolberg, who describes, and discusses, the latitude determinations made at Hamburg in 1904–6. The observations were made with a Repsold portable transit instrument, and a great part of the time was spent in determining and discussing the instrumental errors. The actual latitude observations were made in 1905, and consisted of 426 complete measures of 90 pairs of stars. These are discussed, with the reductions, at length, and a mean latitude of $53^\circ\ 33'\ 6{\cdot}05'' \pm 0{\cdot}015''$ is found for the position of the circle.

Dr. Graff is responsible for the work described in parts ii. and iii., and in the former he describes his observations, measures and drawings of Saturn during 1907, when the ring system and the earth lay in the same plane. The three plates carry twelve drawings, and form an interesting record of the various appearances of the edges of the rings from July 26 to November 30, 1907.

Part iii. is of less general interest, but is a useful reference work. It contains the places of 580 variable stars, lying between the North Pole and 23° south declination, for the epoch 1900·0. The objects are given under their various constellations first, and are then collected into a general catalogue showing the number, the name, the maximum magnitude, the coordinates for 1900·0, the precession, and the B.D. number for each star.

The volume is in quarto form, neatly and strongly bound, and altogether promises the addition of a valuable series to current astronomical publications.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Upper-air Temperatures Registered Outside and Inside Balloons

Attention has been directed several times in Nature to the interest attaching to the knowledge of the rate at which the gas inside rubber balloons takes up the temperature of the air outside. In this connection the results of two registering-balloon ascents from Manchester, made at the suggestion of Mr. Gold, are useful as giving some idea of the magnitudes of various possible errors.

The ascents were made on July 2, 1909, at 6.50 a.m. and 10.17 p.m. respectively. Each balloon carried two instruments, of which one was suspended in the usual manner about 4 metres below the balloon, while the other was fixed inside the balloon. The latter instrument was kept approximately in the centre of the balloon by means of rubber stays. The results are given in the following tables :—

Table I.—(6.50 a.m. *Ascent.*)

Height (ks.)	Temperature °C.		
	Instrument outside Balloon.	Instrument inside Balloon.	
		Ascent.	Descent.
0	10·8	16	12
1	7·0	16·5	7
2	+ 4·5	15·5	+ 5·5
3	− 0·5	13·5	− 0·5
4	− 6	10	− 4
5	− 12·5	4·5	− 13
6	− 19	+ 1·5	− 18
7	− 24·5	− 1·5	− 23·5
8	− 31·5	− 6·5	− 31·5
9	− 39·5	− 9·5	− 38·5
10	− 44	− 14	− 44
11	− 45	− 15	− 47·5
12	− 44	− 13·5	− 49
13	− 43	− 10	− 48·5
14	− 41·5	− 6	− 47
15	− 39·5	− 2·5	− 42·5

Table II.—(10.17 p.m.)

Height (ks.)	Temperature °C.	
	Instrument inside Balloon.	
	Ascent.	Descent.
0	11·5	10
1	+ 2·5	+ 6
2	− 0·5	− 0·5
3	− 6	− 6
4	− 11	− 11
5	− 17	− 17
6	− 23	− 23
7	− 28	− 31
8	− 34	− 38
9	− 40·5	− 44
10	− 48	− 50
11	− 55·5	− 56
12	− 55·5	− 57·5
13	− 56	− 58·5
14	− 57·5	57·5

The traces of the two instruments sent up at 6.50 a.m. emphasise the large possible error arising from insolation should the vertical velocity of the balloon fall below the value necessary for efficient ventilation. The temperatures recorded during the ascent diverge as the height increases, the maximum difference—nearly 40° C.—occurring at the maximum height attained, *i.e.* 15 km. That the divergence is not due to a systematic difference between the two instruments is shown by their good agreement during the greater part of the descent. In this connection it is of interest to compare the experimental results with the mathematical computations made by Mr. Gold in Nature, March 18, 1909, p. 68.

Substituting in his equations the values corresponding to the Dines instrument and the small rubber balloons employed in the ascent, and assuming that half the incident solar radiation is absorbed, we find that $(T-\theta)$, the temperature difference between the gas inside and the air outside, may be 20° C. This is considerably less than the actual value found (30° C.), but the discrepancy is easily explained by the fact that the radiation which penetrates the semi-transparent envelope strikes the almost unventilated instrument inside. That this accounts partly for the difference is evidenced by the fact that the temperature ceases to fall near 11 km., where the pressure is about 150 mm., *i.e.* the pressure below which the natural convection has been found to be ineffective.

The night ascent gives more definite information. The trace of the outside instrument in this case was defective, and it was assumed that the descent readings of the inside instrument gave a close approximation to the readings of the outside one. The doubling of the trace at low altitudes is due to the high initial temperature of the gas inside the balloon—that of the laboratory in which it was filled—and to the effect of daily variation of temperature during the time interval between the beginning of the ascent and the end of the descent. From 2 to 6 km., however, the temperature inside the balloon is the same as that of the outside air. At about 6 km., where there is a considerable increase in the temperature gradient, a lag is developed, which increases to about 8·5 km. where the temperature difference reaches 5° C. Subsequently the lag steadily diminishes, and at 10·5 km. the temperatures are again in agreement to within 1° C. Applying Gold's equation to this case, we find, on substituting the values appropriate to the ascent, that the theoretical lag at 11 km. is about 0·7° C., a rather remarkable agreement in consideration of the fact that the equation is admittedly only approximate. It would appear, therefore, that what might be called the "natural" lag of the balloon temperature in night ascents is small, and that the lag indicated between 6 and 11 km. arose from special circumstances possibly connected with the humidity of the air. The difference between the ascent and descent traces above 11 km. may possibly be attributable to the same cause as the divergence from 15 to 10 km. of the descent traces of the two instruments employed earlier in the day. The results demonstrate conclusively the very large effect of solar radiation compared with that of terrestrial radiation, and indicate that errors in temperature due to air which has already been in contact with the balloon and to radiation from the balloon are, in night ascents, negligible.

In the daytime, however, errors arising from these causes may be considerable. This may, in fact, explain why the differences between the upward and downward traces in ascents by day are more frequent and of greater magnitude than those found for night ascents.

W. A. Harwood.

Physical Laboratory, University, Manchester.

Avogadro's Hypothesis.

I should like to direct the attention of Mr. Woolhouse (Nature, January 20) to the little book "Avogadro and Dalton, the Standing in Chemistry of their Hypotheses" (Edinburgh: W. F. Clay, 1904), in which Dr. Meldrum discusses with great force and discrimination the exact position which should be given to Avogadro's hypothesis. Dr. Meldrum also deals faithfully with those who have made light use of the word "law."

A. Smithells.

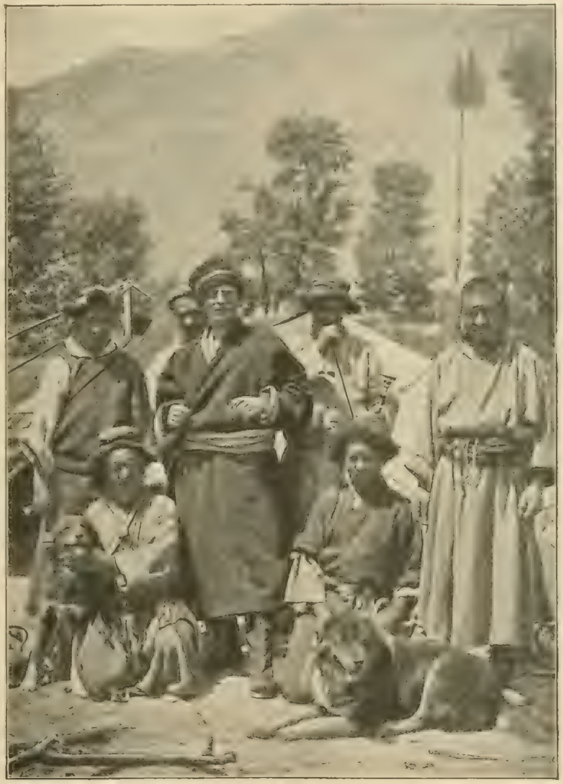
The University, Leeds, January 24.

SVEN HEDIN'S "TRANS-HIMALAYA."[1]

THE special quest of Dr. Sven Hedin in his last and greatest journey of geographical exploration in Tibet was that hitherto unexplored range of mountains, which was believed to rise within the unsurveyed white patch of desert on the "Roof of the World" to the further side of the Tsangpo or Brahmaputra, behind the Himalayas. Although this immense chain, stretching for about 600 miles, is one of the mighty mountain ranges of the earth, and forms the northern watershed of the great Brahmaputra, as well as of the Upper Indus, yet its very existence, even, was largely the subject of conjecture.

A line of high peaks in this desolate region was first reported about 200 years ago by a party of surveyor-Lamas, who had been trained and sent out into Tibet by the Jesuits of Peking, under the patronage of the emperor, Kang-hsi; and the peaks, as located and named by these Tibetans, and rediscovered by recent travellers, figure on the rough map, published by D'Anville, in A.D. 1733. Brian Hodgson, in 1848, as the result of his inquiries in Nepal, depicted these peaks in his sketch-map as forming portions of a hypothetical range of mountains, stretching continuously from the Karakorum and Pamirs on the west to the Tengri Nor lake near Lhasa on the south-east; and he assigned to it the name of "Nyenchen," after the name of the highest peak near its Lhasa end. In the map attached to Huc's travels, this range is also represented as an unbroken chain; and so, too, in Saunder's map of 1879 in Markham's "Tibet"; whilst Grenard, the companion of the ill-fated de Rhins, in 1899, indicates it conjecturally as a double range, which Colonel Burrard, of the Indian Survey, in his recent book on the geography of Tibet, has called the "Kailas Range," after the famous Mount Olympus of the Hindus, at its northern end. So great, indeed, was the need for the exploration of these mountains deemed to be that the president of the Royal Geographical Society declared a few years ago that: "In the whole length, from the Tengri Nor to the Mariam La, no one has crossed them, so far as we know" (a statement, by the way, not absolutely correct, as the pundits Nain Sing and A-K. and Littledale had crossed them) " . . . . I believe *nothing in Asia is of greater geographical importance than the exploration of this range of mountains.*"

This, then, is the range to which Dr. Hedin now assigns the appropriate name of "Trans-Himalaya," after having zigzagged across it by eight different passes, and after mapping out its contours in considerable detail.



Sven Hedin.

FIG. 1.—The members of the last Expedition in Poo. From "Trans-Himalaya."

More than this, the two handsome volumes in which Dr. Hedin tells the story of this great achievement differ from all his previous books on the "Forbidden Land" in possessing greater human and living interest. For the first time, after his many previous years of travel in that country, he has been able to penetrate beyond the desolate deserts and reach a portion of what he truly terms "*Tibet proper*, that is the part chiefly inhabited by a settled population." For this good fortune and for the more friendly treatment generally which he experienced at the hands of the Tibetans he is indebted directly to the amicable relations established with Tibet by the British mission of 1904, none the less real and genuine though cultivated at the point of the bayonet. These relations of friendship and respect, strengthened and cemented by the visit of the Grand Tashi Lama to India in 1905 to meet the Prince of Wales, have enormously increased the prestige of the European throughout Tibet and Central Asia. Thus, a section of Younghusband's mission with four British officers, unaccompanied by any escort of their own, but relying solely on the protection of the Tibetans, was able to pass in a friendly way through those inhabited districts of Tibet, two years before Dr. Hedin visited them; and several other Europeans have visited the Tashi Lama's palace and the western capital. In particular, Lord Minto, the Viceroy of India, to whom the author gratefully dedicates his book, "used his influence with the Tashi Lama so that many doors in the forbidden land formerly tightly closed were opened to me."

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[1] "Trans-Himalaya, Discoveries and Adventures in Tibet." By Sven Hedin. With 388 illustrations from photographs, watercolour sketches and drawings by the author and 10 maps. In 2 volumes. Vol. i., pp. xxiii+436; Vol. ii., pp. xvii+441. (London: Macmillan and Co., Ltd., 1909.) 30s. net.

The start, under such favourable conditions, was made in August, 1906, from Ladak, by way of Kashmir, as the recent treaty with China absolutely prohibited Europeans entering Tibet across the Indian frontier, and could not be relaxed by the Indian Government even in favour of Dr. Hedin, much to his freely expressed vexation. He gave out that he was proceeding to Turkestan, but in the solitudes, a few marches out of Leh, he crossed the lofty Karakorum range and turned southwards into the great elevated Tibetan desert, the Chang-tang. Here he pushed on through the stark solitudes, day after day for two months, surveying the country, without meeting a soul until he crossed the Trans-Himalaya near the capital of Western Tibet. The first nomadic herdsmen he encountered were friendly and acted as guides and supplied provisions and baggage animals. They, as well as their chief, informed him of the friendly passage that way of the British officers saying that "now Europeans seem to be privileged to pass through the country." In a few days more, Tibetan couriers arrived with his European letters, which had been sent on by the British agent through the Tashi Lama, at the request of Lord Minto; and accompanying these letters, were welcome stores of European provisions, newspapers, books, &c., as presents from the British agent at Gyantse; and, most important of all, an official to guide and assist Dr. Hedin through that inhabitated portion of Tibet to the Tashi Lama's capital.

Thereafter, writes our author, "the route was as free to us as the uninhabited Chang-tung had been. We should pass black tents daily, be able to buy all we want. We enjoyed unlimited freedom, and had not a single man with us as escort or watchman." Arrived at the capital, Shigatse, he says, "the priests welcome us with kindly good-tempered smiles," and he was installed as the favoured guest of the Tashi Lama, the second of the "Living Buddhas," who received him cordially several times. This high honour which he procured through Lord Minto, proved so invaluable to Dr. Hedin, that, as he writes, "eighteen months later it came about that chiefs and monks said *Bonpo Chimbo* [great lord!] we know that you are a friend of the Tashi Lama, and we are at your service!" His Holiness, it is interesting to learn, has been a keen photographer since his visit to India, when he was initiated into the mysteries of the art by British officers. In his palace he has had a dark room fitted up, where the developing is done by one of the young priests who accompanied him to India. Whilst halting at the Tashi Lama's capital, our traveller lightened his baggage by sending back to Europe, through the British officer at Gyantse, his survey records, note-books, photographic plates, rock-specimens, &c. Here, also, he witnessed the new-year's carnival and festivities, and was allowed to roam freely over the famous palace of the monastery of the Tashi Lama, a busy hive of four thousand ascetics; but, unfortunately, our author, through want of special knowledge, has not added anything to our information on these interesting subjects.

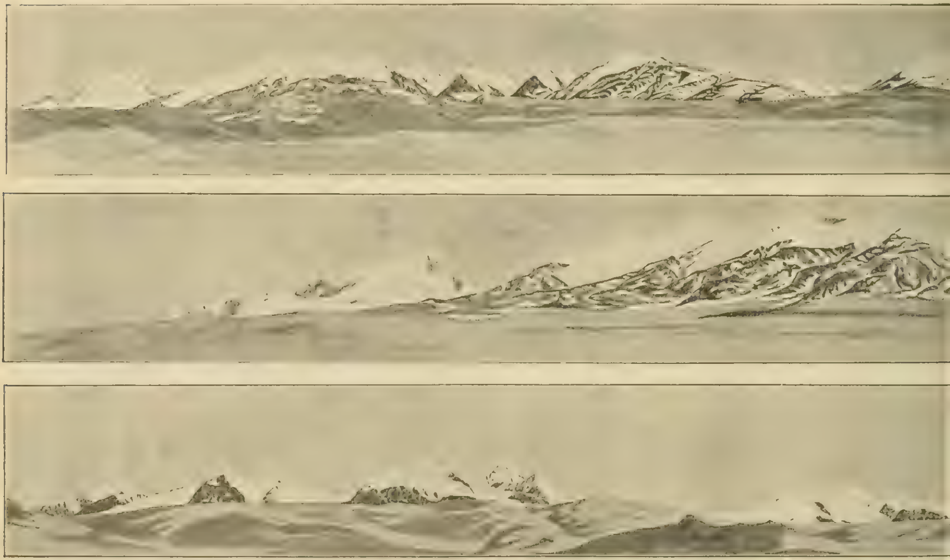

FIG. 2.—The Summits of Lunpo-Gangri from three Camps. From "Trans-Himalaya."

His stay at Tashilhunpo was brought suddenly to an end by the Chinese officials at Lhasa, who insisted on the Tibetans enforcing the treaty, so that Dr. Hedin was compelled to return forthwith to Ladak under a guard. On the way, he succeeded in eluding his guard and made a detour across the Trans-Himalaya by two fresh passes; he also discovered a new western source of the Brahmaputra, and took a series of soundings over Lake Manasarowar, by means of his portable boat.

On return to Ladak, with characteristic pertinacity, he decided to make a second expedition back again to Tibet, in order to complete his partial exploration of the Trans-Himalaya, as he reflected that, "it was especially irritating to think that others might come here and rob me of these conquests." So with a fresh caravan, got together with the aid of the British officials, he plunged south once more through the terrible Tibetan deserts, and much astonished the discomfited Tibetan chiefs by his reappearance amongst them a year after they had got rid of him with such infinite pains. In this latter traverse, three more passes were surveyed, with the result, to quote the author's own words, that, "When I passed over the Trans-Himalaya for the eighth time at Surnge-la, I had the satisfaction of seeing all the old hypotheses fall down like a house of cards and a new ground plan laid down on the map of Asia, where before the blank patch yawned with its alluring 'Unexplored.'" This mountain-system, it is remarked, cannot be called "a range," because it is a collection of several ranges, more or less parallel or branching off at various angles; Dr. Hedin, however, will find that somewhat similar features are displayed by the Himalayas themselves.

The narrative of the two years' strenuous journeyings for the survey of these formidable mountains, is written in a vigorous, direct, style, which reflects the cheery optimism of this pioneer traveller as he pushed on undaunted, in the face of endless hardships and difficulties. It also shows him animating his men with something of his own abounding enthusiasm, without which, indeed, the exploration could never have been accomplished. The reader feels the swing of the caravan moving through the pages, with the thrill of reality and a pervading sense of danger ahead; though to many readers the repetition from day to day of the details of camp routine, and the reiterated records of the grim struggles of the men and the sufferings and painful deaths of the dwindling baggage animals, will doubtless make somewhat monotonous and unpleasant reading after a time.

Besides the geographical record, so important in itself, and the camp episodes, there is little else that is new. Remarkably few references occur in respect to natural history; scarcely any mention or passing recognition is made of wild animals, or plants, or minerals, such as we expect in the journal of a scientific traveller; and the few remarks which occur in regard to the people and their customs exhibit a lack of familiarity with authentic sources of precise information, and the well-known researches of Rockhill and others. Incidental reference is made to a collection of rock-specimens, the description of which by specialists, is promised along with the detailed maps, which will doubtless be accompanied by an analysis of other objects collected, though no mention is made of them. The young Indian elephant of the Tashi Lama, we are told, "is the only one of his species in the whole country"; but the Talai Lama, we know, has (or had in 1904) a much larger tusker, a present from the Sikhim raja, which had survived the arctic winters of many years at Lhasa, and was housed in a grove near the British mission camp outside that city in 1904. "A *Bod* or Buddhist" is spoken of as if these two terms were equivalent, whereas the former means a Tibetan or inhabitant of *Bod* or Tibet. The "*Bothiyas*" (*sic*) are described as "a mixed people sprung partly from Indian and partly from Tibetan elements," whilst in reality, "Bhotiya" is merely the Indian designation of the Tibetan race or people of *Bod*. A want of precision in the spelling of several of the vernacular place-names is noticeable in a professedly geographical work, thus "Sekiya" invariably occurs in the text for the well-known monastery and sect of Sakya or Saskyas, and "Yere-tsangpo" for the Yaru (or "upper") Tsangpo; and many of the names are spelt phonetically according to no regular system. To say "Hor or Bod-yul" is equivalent to saying "Turkish or Tibet." In regard to the term used for the great Manasarowar Lake by D'Anville in his old map, namely "*Ma-pama Talai,*" or Ma-pama Lake, Dr. Hedin gives "Ma-vang" as the correct form, but this latter is merely the vulgar vocalization of the name, which is spelt and properly pronounced as "*Ma-pàm*"; and our author sagely states that "D'Anville might have added that the Chinese and Talai or Dalai means ocean," and that it was used to imply that this particular lake was larger than the other neighbouring lakes mentioned in his text. This, however, is not correct; "Tālai" is *not* Chinese, but a Mongol word, and it is applied to all the lakes in that neighbourhood, as well as throughout the Northern Himalayas, irrespective of their size; and in the abbreviated form of "*Tāl*" it was imported into Northern India by the Moghal section of the Mongols, and is now naturalised there as the current vernacular name for a lake. Deficiencies of this kind, however, can be corrected in another edition, and in no wise belittle the outstanding importance of Dr. Hedin's splendid geographical achievements.

These attractive volumes, with their wealth of sketches and beautiful photographs, deserve nothing but praise, and form a fitting record of Sir Sven Hedin's magnificent pioneer work amongst one of the most forbidding mountain ranges in the world. This work, too, is of such importance to Indian hydrography as to have gained for its author, amongst other well-earned honours, a knighthood of the Indian Empire. It is also pleasing to observe that his men have not been forgotten, for the thirty-seven Asiatics who followed the explorer faithfully through Tibet, and, as the author generously admits, "contributed in no small degree to the successful issue and results of the expedition," have been rewarded with gold and silver medals, bestowed by the King of Sweden.

COLOUR-BLINDNESS.

FOR a considerable time past dissatisfaction has been felt in certain quarters with the methods adopted by the Board of Trade in examining in colour-vision candidates for certificates as master or mate in the mercantile marine. On June 30, 1909, Lord Muskerry directed attention to the matter in the House of Lords, using the cases of Mr. W. H. Glover and Mr. John Trattles as the text of his argument, and moving that a Select Committee be appointed to consider the conditions under which eyesight tests for the mercantile marine certificates were conducted. Lord Hamilton of Dalzell, in reply, stated that during the last four years 25,151 candidates were examined; of these 239 failed in the colour-vision tests; 64 appealed, with the result that 27 passed and 37 were rejected. The tests, based upon the report of a committee of the Royal Society, which sat at the request of the Board of Trade in 1890, were considered to be efficient as at present carried out. He held that no case had been made out for the appointment of a Select Committee. The Marquis of Salisbury said he had, perhaps, a special claim to be heard in this matter, because he was colour-blind himself. He was convinced that colour-blindness was capricious; on some days he was very much more colour-blind than on other days. But from the point of view of the Board of Trade and of the mercantile marine such caprice must be very dangerous. The motion was by leave withdrawn.

Since this debate in the House of Lords the case of Mr. John Trattles has assumed greater importance, and it will be well to recount briefly its history and the chief features which it presents. In February, 1904, Mr. Trattles was examined for his certificate as second mate; he passed the colour-vision test, and was granted his certificate. In July, 1905, he went up for examination as first mate, and failed in the colour-vision test. He appealed, and was specially examined by Sir William Abney and Captain Harvey, and again failed. In September, 1905, having refused to surrender his certificate as second mate, a Local Marine Board was called to inquire into his competency. The board found that he was not incompetent to hold his certificate by reason of colour-blindness. In May, 1906, he was examined for a certificate of competency as first mate; he passed the examination, including the sight-test. The Board of Trade was not satisfied, and, after some correspondence, he was offered and accepted a special examination by Sir William Abney and Captain Harvey. It took place in May, 1909, when he again failed in the colour-vision test. He declined voluntarily to surrender his second mate's certificate, and the Board of Trade instituted a special court, consisting of Sir Francis Mowatt, president, with Mr. J. Dickinson, stipendiary magistrate, as legal assessor, to decide the issues. Mr. Trattles therefore came before this court after six examinations in colour-vision during the last six years; on three occasions he passed, and on three occasions he failed.

On the occasion of the special examination by Sir William Abney and Captain Harvey in May, 1909, owing, presumably, to the agitation in the medical and lay Press against the methods adopted by the Board of Trade, certain scientific bodies were invited to send representatives to witness the tests. Dr. W. H. R. Rivers, F.R.S., lecturer in the physiology of the senses in the University of Cambridge, and Mr. J. Herbert Parsons were present, representing the Royal Society and the Ophthalmological Society respectively. These gentlemen were not informed that the case was one likely to render desirable their evidence as witnesses in a court of law. Dr. W. Ettles, who had examined Mr. Trattles, and was of opinion that he was not colour-blind, was also present.

The special court commenced its sittings on December 2, 1909, at the Imperial College of Science and Technology, South Kensington. Evidence was given by Sir William Abney, Dr. Rivers, Mr. Herbert Parsons, Captain Harvey, Captain Fulton, and Fleet-Surgeon Prynn, R.N.; they concurred in their opinion that Mr. Trattles was colour-blind. Mr. Trattles's witnesses included himself and several well-qualified captains, who had had extensive experience of his skill and ability in navigating ships under conditions of difficulty in the North Sea, the Baltic, the Channel, the Atlantic, the Mediterranean, the Black Sea, and in the Mersey. We do not notice the name of Dr. Ettles in the reports we have seen; we should have thought that he would have been an important witness for the defence. Mr. Trattles submitted to an examination before the court, conducted by Sir William Abney. The court further allowed a practical test, conducted by Commander Wilson-Barker, R.N.R., who was nominated by the Trinity House Brethren. It took place on the evening of December 30, when it was "calm, with some haze on the horizon." Commander Wilson-Barker reported that "Trattles had no difficulty whatever in picking up the lights. He had vision of a quality equal to that of myself and of the look-out man." He instanced two tests to which he attached special importance. On approaching the Nore light at some distance off, Trattles hesitated, questioning if it was not a reddish light. He was correct, the light being a new white light in which some ruby rays are retained as an experiment in penetrating the fog. Trattles was asked to describe the colour of two planets which the Commander pointed out to him from the deck; he did not recognise them, but he correctly described one of them (Mars) as reddish. Sir Francis Mowatt came to the conclusion that Trattles is not incompetent from colour-blindness to discharge the duties of a mate, and directed that his certificate as second mate be returned to him.

We have quoted this case at considerable length because, in our opinion, it demonstrates beyond dispute the urgent need of reform in the methods of conducting inquiries into the colour-vision of candidates by the Board of Trade. Here is a man, with an unimpeachable record in his profession, whose life must have been made a misery from anxiety as to his future career. On the other hand, the public cannot but feel perturbed at the thought that numberless lives are endangered if mistakes are allowed to occur. There are obviously two explanations of the anomaly that the same man may be rejected by the same tests conducted by different examiners; either the tests themselves are at fault or, if efficient, they are not applied with sufficient care or accuracy. Experts whose opinions cannot be lightly disregarded will be found to support both these contentions. For our own part, for reasons which it would take too long to enter into on the present occasion, we incline to the second alternative. The preliminary examinations are conducted by men who have no knowledge of physiology, whatever their other qualifications may be. Even on appeal there is no physiologist amongst the examiners.

We do not wish to labour this point unduly, but owing to the manner in which it has been neglected in the past it merits serious consideration. Defects of colour-vision are defects of a physiological condition, and belong to the class of conditions which the physiologist is accustomed to deal with. Every physiologist to-day must perforce be a more or less accomplished physicist; every physicist is by no means called upon to be an equally accomplished physiologist. The physiologist is familiar with those tantalising variations which characterise living matter, induced by the lability of the medium and the complexity of the forces brought to bear upon it. Even amongst physiologists and ophthalmologists, only those who have devoted particular attention to this highly specialised branch are fully qualified to deal with it. Normal colour-vision shows a great range of variations under differences of intensity of stimulation, differences of adaptation of the retina, differences of the psychological condition, and in different individuals. To take a simple example, the fields of vision for colours vary according to the intensity of the stimulus. Defects of colour-vision show an equally wide range, and whilst it is possible to group the cases according to certain well-defined types, there is none of that accuracy of definition in the scientific picture which rejoices the heart of the physicist. Whilst comparatively gross tests, such as the ordinary tests with Holmgren's wools, used in preliminary examinations by the Board of Trade, suffice to distinguish the graver forms of defective colour sensation, they cannot, as ordinarily applied, be regarded as infallible in less pronounced cases—cases which may yet involve danger to many lives if they are allowed to pass unrecognised. Hence occurs the necessity for more delicate tests, physical indeed in their nature, but only to be interpreted accurately in the light of a comprehensive knowledge of the physiology of vision.

We have the profoundest respect for the work which Sir William Abney has done upon the subject, and every competent critic will endorse the opinion of Lord Rayleigh, quoted by Lord Hamilton of Dalzell, that the Board of Trade could not be wrong in following his advice. How is it to be explained, then, that his opinion, endorsed by other competent men of science, is not accepted as final? We think that it is largely due to the difficulty, or rather impossibility, of conveying to laymen any adequate conception of the peculiarities of vision of the colour-blind. The difficulty is enhanced by the terminology and phraseology adopted by the expert, who almost invariably speaks, as it were, in the language of the theory of colour-vision which he personally affects. Thus, Sir William Abney describes a man in terms of the Young-Helmholtz theory as *red-blind,* whilst Dr. Rivers, agreeing entirely with the facts of the colour-vision of the individual, describes him as *red-green-blind,* and would doubtless prefer to avoid all ambiguity by calling him scoterythrous. Every statement which either might make in endeavouring to convey some idea of the visual perceptions of a colour-blind individual to one who has had no training in the physiology of the senses might be implicitly relied on for accuracy when rightly interpreted, but the probabilities of correct interpretation are exceedingly small, if, indeed, the whole statement is not regarded as a meaningless jargon.

Further, the layman fails wholly to understand why recondite tests, such, for example, as that with simultaneous contrast colours, should be imposed upon the examinee. He can comprehend "practical" tests on board ship, such as that to which Mr. Trattles submitted. It would surprise him greatly to be told that under favourable atmospheric conditions the expert would fully expect a colour-blind person to pick up lights with unfailing accuracy.

The Trattles case will have served an invaluable purpose if, as must inevitably be, it focusses public opinion upon the glaring anomalies of the examination in colour-vision of candidates by the Board of Trade. It appears to us to be imperative that all the conditions should be re-investigated by a competent body, either a carefully selected Royal Commission or a committee of the Royal Society upon which physiologists and ophthalmologists who have devoted special attention to the subject are adequately represented. Among the duties of such a committee would be:—

(1) Re-investigation of the tests for colour-blindness with the view of the adoption of methods less open to attack, and, if possible, of a simpler nature.

(2) Re-organisation of the examinations and of the boards of examiners.

We have no doubt that it would be possible so to revise the conditions of the Board of Trade examinations that it would cease to be necessary to have recourse to a court of law for adjudication on the results of a purely scientific question.

NATURE PHOTOGRAPHY.[1]

THE object of Mr. Bedford's book is to encourage the pursuit of nature photography among those who cannot afford either the time or expense to undertake very advanced work in this direction. The author rightly points out that there are great advantages in this method of studying nature over the older method of collecting, and that the study of natural history by means of photography may be taken up by those whose time and means are strictly limited. The first part of the book deals with the apparatus required. A detailed description is left to text-books on photography; some knowledge of cameras and photographic methods is assumed, and the author confines himself to suggestions and to an account of the particular kinds of apparatus which he himself has found serviceable. On the whole, this part of the book should be valuable to a beginner taking up the subject for the first time, but one feels that in some parts space is wasted in describing processes of which a sufficient account is given in every book on photography, and other parts might with advantage be made more full, for in places the reader is left with no clear idea of the nature of the instrument or process recommended. Rough estimates of cost might also have been included; several times we are told that the choice must be decided by the possible outlay, but no actual estimates of expense are given.

The second part of the book deals with the actual photography of living objects. In the chapter on choice of subjects, the author very rightly emphasises the fact that a connected series of photographs of one subject or group of subjects is of much greater interest and value than an indiscriminate collection of pictures of isolated things. This is illustrated in the book by the series of plates (Figs. 69–76) showing the early life of a young cuckoo. We regret that the chapter was not extended somewhat, at least so far as to emphasise the value of photographic records of objects which cannot easily be collected or preserved in their natural condition, such as fungi, insect larvæ, or fruits. As an illustration of the excellent results that may follow from the patient collection of photographs of such things, one may mention Connold's useful book on "British Oak Galls."

Red Admiral Butterfly (wings expanded). From "Nature Photography for Beginners."

The chapters on how to observe and photograph the commoner birds and their nests take the form of a conversation, or rather discourse, to an imaginary novice during a series of birds'-nesting excursions. This style of writing is very irritating, as are the frequent references to the pleasures of tea in the country, and these chapters might lead one who had never searched for nests to believe that one could be found in every bush in which it was sought. It is to be regretted that the author did not put his evidently considerable knowledge of nesting-habits into different form. The succeeding chapter, on curious nesting-places, where the author's experience is told straightforwardly, is much better. The concluding chapters, on photographing animals and flowers and on protective colouration, are so sketchy as to be of little practical use, and we note some mistakes, *e.g.* the statement on p. 161 about the cause of colour differences in moths probably has no foundation.

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[1] "Nature Photography for Beginners." By E. J. Bedford. Pp. xiv+168. (London: J. M. Dent and Sons, Ltd., 1909.) Price 7s. 6d. net.

The style of the whole book is colloquial, and sometimes marred by not very successful attempts at wit.

The book is illustrated by a number of very pretty photographs, which are distinctly good, but not of the striking character made familiar by some other nature-photography works. Nearly all are stereoscopic, and a stereoscope is supplied with the book which adds considerably to their usefulness. Unfortunately, the stereoscope makes the texture of the process-block unpleasantly conspicuous. Although the photographs are not especially striking, they illustrate well the kind of work which an amateur who is limited in time or means may hope to produce.

THE NEW COMET (1910*a*).

THE comet discovered near Johannesburg on January 16, as announced in last week's NATURE, has justified the opinion then expressed as to its becoming a brilliant object in our evening skies. From many parts of the civilised world we hear of crowds gathering to watch the rare phenomenon, and the daily Press, despite the General Election excitement, has devoted considerable space to the description of the "Daylight Comet."

Apparently the comet was first seen by some miners on January 16, and reported to Mr. Innes, of the Transvaal Observatory, Johannesburg. Messrs. Worssell and Innes made the first measurement of its position at 19h. 29·2m. G.M.T. January 16, that is, at 9.29 a.m. on January 17 local standard time, when the sun would be well above the horizon. The measures were continued until January 17, 0h. 8·6m. (Johannesburg M.T.), that is, midday, and they showed that the comet was rapidly approaching the sun, the apparent movement per hour being +42s. in R.A. and +6·5′ in declination.

Mr. Innes described the comet as having a head 5′ in diameter, and a well-developed tail; in a later message the latter was stated to be 1° long, fan-shaped, and visible to the naked eye. This observation emphasises the exceptional brilliance of the comet and the purity of the Transvaal atmosphere, for at the time of observation the comet was within 4½° of the sun and west of it.

The apparent motion was so rapid that by the time the discovery was announced here the comet had passed to the east of the sun, and was therefore to be seen at or after sunset instead of before or at sunrise. The Cambridge Observatory appears to have been the most fortunately situated of English observatories, for the sky was clear enough on January 19 to warrant an attack in force, and Mr. Hubrecht was, according to Saturday's *Daily Mail*, fortunate enough to find the comet straight away. Mr. Hinks thereupon secured a measure of the position, and saw a nucleus as bright as Mercury, and a tail 2° long; on Thursday, January 20, the nucleus was seen to be brighter and the tail further developed.

According to a Central News correspondent, the comet was seen, in full daylight, at the Milan Observatory, but no tail was seen. The observations of the tail vary considerably in their estimates of its length, but this is to be expected, for, obviously, the prominence of such a filmy structure in daylight or twilight will vary greatly with the purity of the atmosphere.

At Oxford, Prof. Turner found the comet quite a conspicuous object, in field-glasses, at 5 p.m. on January 20, and could see it quite easily with the naked eye; he made his observations from the Robinson Tower of New College.

On Friday, January 21, the Cambridge observers were again favoured, and, according to the *Times*, Mr. Hinks found the comet to be considerably brighter than on the preceding day, and to have a fine stellar nucleus with the surrounding envelopes well developed. Prof. Dyson, at the Royal Observatory, Edinburgh, also saw the nucleus. The same day, Mr. J. H. Elgie, observing at Leeds, saw the comet at 5 p.m., and describes it as "weirdly magnificent," having a tail 8° long. The nucleus, he estimated, was as bright as Mars at the recent opposition, and the tail was curved, with the concave side towards Venus; the outer edge was then well defined, but further observations, on Saturday, showed it to be much more diffused. The Rev. F. J. Jervis-Smith, writing from Lymington, says that several persons observing there on January 22 thought the tail appeared to flash slightly and continuously, but this phenomenon may have been due to the low position of the object and consequent atmospheric effects.

The lengthy reports in Monday's *Times, Daily Mail, Chronicle*, &c., show that the comet was well observed during the week-end. On Saturday, January 22, Prof. Turner secured two photographs showing the brighter portions of the tail, and four photographs were taken at the Dunsink Observatory. Dr. Whittaker and his assistants at Dunsink also observed the comet visually, and found that, in addition to the tail, extending upwards to a distance of 8°, where it was lost in a dense cloud, there was a distinct jet, or horn, of light on that side of the head nearest to the horizon. The head of the comet appeared as a dusky-red nucleus surrounded by a nebulous envelope of fainter red, and was as large as, or larger than, Mars. The twin tails were of a bright yellow colour.

Dr. Rambaut observed the comet with the 10-inch and 18-inch telescopes at the Radcliffe Observatory on January 22, and saw it quite well, despite a thick haze. Prof. Dyson also made observations at Edinburgh, and found, at 5.25 p.m., that the head was as bright as Mars and had a nucleus 45″ in diameter, whilst the tail extended to a distance of 7°. At Cambridge it was estimated to be 6° long. The orbit computed by Messrs. Stratton and Hubrecht, at Cambridge, shows that the comet passed through perihelion on January 17, at a distance of two million miles from the sun, and will continue to move northwards with diminishing speed.

At the Solar Physics Observatory, South Kensington, and, we understand, at the Royal Observatory, Greenwich, the careful preparations for observing, and the constant attendance of the staff during the hours available for observations, were, until Tuesday evening, rendered nugatory by clouds, or by the persistent smoky haze which, even on Saturday, rendered Venus a faint object, and made quite hopeless the careful search for the comet. But on Tuesday evening observations were secured by Dr. W. J. S. Lockyer, using the 10-inch refractor, and these showed that, at 5.35 p.m., the Kiel position was in error to a slight extent in R.A. and about 2° in declination, the observed place being further south than that indicated by the ephemeris.

In a telegram transmitted by Prof. Pickering to the

Astronomische Nachrichten (supp. No. 4383) it is announced that Dr. Wright, of the Lick Observatory, has made a daylight observation which shows the spectrum of the comet's nucleus to be continuous, with the sodium, D, lines bright. Similar observations are reported in the *Daily Telegraph* (January 24) from the Glasgow Observatory, with the addition of a "hydrocarbon" band. This occurrence of the D lines recalls the Wells's, and the Great, comets of 1882, in which Copeland and Lohse observed the same lines intensely bright, due, according to Copeland, to the near approach of the comet to the sun. In the present case the rapidity with which the comet appears to have travelled when near perihelion further suggests a similarity.

The publication of a set of elements and an ephemeris by the Kiel Centralstelle (Circular No. 117) provides for observations during the next few days. The elements are based on observations made at Algiers on January 18, 19, and 20, and are as follows:—

Elements.

$$T = 1910, \text{ January } 17{\cdot}42 \text{ (M.T. Berlin).}$$

$$\left.\begin{aligned}\omega &= 263^\circ\ \ 5{\cdot}7'\\ \Omega &= \ \ 8^\circ\ 56{\cdot}2'\\ i &= \ 62^\circ\ 10{\cdot}1'\end{aligned}\right\} 1910{\cdot}0$$

$$\log q = 8{\cdot}6169$$

The following is an abstract from the ephemeris:—

Ephemeris for oh. (M.T. Berlin).

1910		R.A. h. m.		Decl. ° ′
January 26	...	21 25·3	...	+0 20
27	...	21 31·2	...	+2 30
28	...	21 36·7	...	+4 14
29	...	21 42·1	...	+6 2
30	...	21 47·2	...	+7 45

Observations made by Prof. Turner, Dr. Lockyer, and others, indicate that this ephemeris is incorrect in declination, and that on January 25 the observed position was about 2° south of that given by the ephemeris. Prof. Turner reports that the discordance is increasing.

Observations made on January 24 and 25 indicate that the comet's brightness is decreasing. In the *Times* of January 25, Sir Robert Ball reported that "Prof. Newall finds a remarkable spectrum," and the Rev. T. E. R. Phillips stated that the double tail was not unlike that of the great comet of 1874, but with the gap in the centre much wider than in that case. Further photographs were secured at Dunsink and Oxford on Tuesday. In the *Times* of January 26 Sir Robert Ball reports that the comet was again observed, between 5 and 6 p.m. on Tuesday. It was much fainter than on Saturday, but the tail was quite 10° long, and was slightly curved towards Venus. The bright yellow light was still present, but fainter.

Bright, "daylight," comets are not frequent visitors; the tale for the nineteenth century is practically completed by the comets of 1843, 1847, 1853, 1861, and 1882, and it is a curious coincidence that this present visitor should arrive at the time when we had settled down to the carefully ordered study of the rediscovered Halley. But reference to the notes presented to the Royal Astronomical Society by Messrs. Cowell and Crommelin will show that the coincidence is not unique; quite a number of returns of Halley's comet have been marked by the appearance of exceptionally bright sporadic visitors.

The present object has been introduced to us under a misnomer. The *Astronomische Nachrichten* now tells us that the appellation "Drake" is simply due to a misinterpretation of "great" as the message was being transmitted by telephone; popularly it is the "Daylight Comet."

W. E. ROLSTON.

NOTES.

WE regret to see the announcement of the death, at Marburg, of Prof. F. Kohlrausch, the distinguished physicist, at seventy years of age.

THE death is announced, at sixty-two years of age, of Prof. H. Brunner, professor of toxicological chemistry in the University of Lausanne since 1876.

THE Friday evening discourse at the Royal Institution on February 4 will be delivered by Prof. W. Bateson, F.R.S., on "The Heredity of Sex."

PROF. A. LACROIX has been elected president for 1910 of the Geological Society of France. M. Œhlert, Mme. Œhlert, Prof. Vidal, and M. Cossmann have been elected vice-presidents. This is the first time a lady has been elected to office in the society.

To the *Field* of January 22 Mr. Lydekker contributes an account of an apparently new race of buffalo obtained by Mr. Hilton-Simpson in the extreme south of French Congoland; the race appears to be allied to the red Congo buffalo, but is of much darker colour.

ACCORDING to a statement in the *Times* of January 17, three skeletons of sauropod dinosaurs have recently been discovered in the Jurassic strata of Utah by a collector from the Carnegie Museum, Pittsburg. One of the three is stated to be higher and more massive than that of the type of *Diplodocus carnegiei*, although its length—84 feet —is somewhat less.

THE council of the Royal Geographical Society has decided to award a special gold medal to Commander Peary for his journey to the North Pole, and for having undertaken such scientific investigations as his opportunities permitted; and a silver replica to Captain Bartlett for attaining eighty-eight degrees north latitude.

ACCORDING to the New York correspondent of the *Times*, the U.S. Department of Commerce and Labour has under consideration the dispatch of the Government steamship *Albatross* on an expedition to the Antarctic Ocean. The expedition is the suggestion of Dr. H. F. Osborn, of the American Museum of Natural History, New York. The objects of the proposed expedition are stated to be partly commercial and partly scientific. There appears to be reason to believe that some of the remote southern islands are the homes of herds of the southern fur seal, and it is hoped to discover these, as well as to study south polar fauna generally.

A SERIES of lectures in connection with the Selborne Society has been arranged, and will be held in the theatre of the Civil Service Commission, Burlington Gardens, London, W. The first lecture of the course was delivered by Mr. F. Enoch on January 21, and dealt with insects through the camera. There was a large audience. The lecture, which aroused great enthusiasm, gave the results of many years of patient outdoor research, and was illustrated by a unique series of three-colour photographs. On February 11 Mr. W. Bickerton will lecture on wild birds and their ways; on March 11, Mr. W. M. Webb on clothes a human nature-study; and, on April 8, Miss Gertrude Bacon on wind, wave, and cloud. Fuller particulars may be obtained from the honorary general secretary of the society, 42 Bloomsbury Square, London, W.C.

IT is with regret that we see the announcement of the unexpected death of Dr. W. Page-May, fellow and lecturer of University College, London, which occurred quite suddenly at Brighton on Wednesday, January 19. To those associated with him at University College, where, during the years since his return from Helwan, he carried out his work on the central nervous system, as well as to a far larger circle of friends, his early death, when he was in the full vigour of his intellect, has been felt as a heavy loss. Dr. Page-May brought a well-trained mind to the study of neurology. He was thoroughly familiar with the literature of this subject, and also with all the special physiological and histological methods which have so largely contributed to those conceptions, which are held at the present time, of the minute structure and modes of action of the brain. Several researches were in actual progress at the time of his death. Among the more important of his papers we may mention the "Investigations into Segmental Representation of Movements in the Lumbar Region of the Mammalian Spinal Cord," published in the Philosophical Transactions of the Royal Society, 1897; and numerous papers in *Brain*, on "The Afferent Path," and, in collaboration with Dr. Gordon Holmes, "On the Exact Origin of the Pyramidal Tracts in Man and other Mammals."

Records of severe earthquake shocks were obtained at many seismological observatories on Saturday, January 22. The following observations of shocks are recorded:—at 7.45 a.m. at Seydisfjord, in Iceland; at Akureyri, in the same island, at about 8 a.m.; at 8.52 a.m. by Prof. Milne at Shide, in the Isle of Wight; at 8.45 a.m. by Prof. Belar at Laibach, in Austria. A disturbance was registered at the Parc Saint-Maur earthquake station, Paris, at 9 a.m., and was most violent from 9.4 to 9.24 a.m. The French observers locate the earthquake as occurring at a distance of about 3000 kilometres from Paris in a south-easterly direction, and it is believed to have visited the Caucasus or Armenia. Prof. Milne is reported to have estimated the distance of the origin of the shock at a little more than a thousand miles. Prof. Belar is said to have given the distance as 2500 miles, and suggests Asia as the seat of the disturbance.

The council of the Royal Meteorological Society has forwarded a memorial to the Royal Commission which is now inquiring into the work of the University of London urging that the time is fully ripe for placing the study of meteorology on a more satisfactory basis, and for its inclusion among the subjects for degree examinations. The council has arranged for a provincial meeting to be held at Manchester on February 23, and it is hoped that this will be the means of making the work of the society better known in a district in which considerable attention is already being given to meteorology. At the annual meeting of the society the president presented to Dr. W. N. Shaw, F.R.S., the Symons gold medal for 1910, which had been awarded to him in consideration of his distinguished work in connection with meteorological science.

Mr. Edward T. Connold, whose death is announced, was born at Hastings on June 11, 1862. He is best known from his researches in connection with British plant-galls, upon which he published the following beautifully illustrated works:—"British Vegetable Galls" (1901), "British Oak Galls" (1908), and "Plant Galls of Great Britain" (1909). At the time of his death he had in preparation a work on British wild fruits. His collection of plant-galls is exhibited at the Hastings Museum, in which institution he took great interest. On the formation of the Hastings and St. Leonards Natural History Society in 1893 he became honorary secretary, and at once entered upon his duties with characteristic enthusiasm. He was an excellent lecturer on popular natural history, while his skill as a photographer is attested by the plates with which his published works are embellished.

We have to acknowledge the receipt of a catalogue of publications relating to "Evertebrata," issued by Mr. W. Junk, of Berlin, and containing more than six thousand items.

Dr. C. Hosseus, of Berlin, communicates to the January issue of *Urania* a brief *résumé* of two collecting trips in Siam, in the course of which much valuable material was obtained. Special attention is directed to the important *rôle* played in Siam by elephants, which, unlike their cousins in India, breed more or less freely in captivity.

Naturen for January opens with a long and well-illustrated article, by Dr. D. Damas, on the oceanography of Greenland, based on the observations made by the *Belgica* expedition of 1905. Maps show the extent of the ice at different seasons, while the bathymetrical variation in salinity is illustrated by diagrams.

In the January number of *Knowledge* the question is raised, under the heading "Zoological Notes," whether there were ever English species-names for many of the better known kinds of animals, the two sexes of which have distinctive designations of their own. As examples may be cited mallard and duck, bull and cow, dog and bitch, and horse and mare. In the opinion of the writer of the note, no species-name originally existed in these and many other cases.

In the Journal of the Quekett Microscopical Club for November, 1909, Mr. W. Wesché states that, having discovered a few years ago the viviparous propagation of the tachinid fly known as *Phorodera serriventris*, he was at a loss to understand why the female required an ovipositor, more especially one of unusual form. The problem was solved by observations made at Mersea Island, off the Essex coast, last summer. From these it appears that, after birth, the living larvæ are introduced by means of a very sharp hook on the under surface of the body of the female into the bodies of caterpillars, the fly making an aperture for their entrance by forcing the hook into its victims. The necessary purchase on the body of the caterpillar is obtained by the grip of the two serrated abdominal plates in advance of the hook, this giving a hold in an opposite direction to the force expended on the penetrating hook. When not in use, the hook is folded in the median line under the abdomen. The larvæ have strong chitinous jaws, which are visible through the integuments of the gravid female, and in one instance the author counted no fewer than ninety-eight jaws, although such a number appears to be unusual.

The greater portion of the contents of vol. xxxi., Nos. 3 and 4, of Notes from the Leyden Museum, is devoted to entomological subjects, among which reference may be made to a paper, by Dr. A. Forel, on ants obtained on Krakatau and in Java by Mr. E. Jacobson, with biological notes by the collector. The latter gives copious notes on the habits of the species known as *Polyrhachis dives*, of which a colony was in the habit of invading the bathroom of his residence. The ants effected an entrance through a chink in the wall, so that the nest could not be discovered. They made their appearance in the evening, but were in no wise disconcerted by gaslight, and so freely did they drink that their abdomens became greatly distended. The author, who kept many of these ants in captivity, gives figures of three of their nests. In July, 1905, he found that many of the ants were badly infested with nematode worms, the stomach of one in dividual containing no fewer than fifteen parasites. A nematode taken by Mr. Jacobson from *Camponotus maculatus* was described by Dr. von Linstow as a new species, under the name of *Ochetocephalus javanicus*, in vol. xxix. of the "Notes."

Prof. G. Haberlandt has arranged with the publishers of his "Physiologische Pflanzenanatomie" to issue separately the chapters from the latest edition of his book dealing with the perceptive organs of plants. This gives botanists the opportunity of obtaining in a small brochure, at a price of two marks, the essence of the experiments and arguments put forward by the author and other physiologists in connection with the statolith theory of gravity-perception, and in favour of regarding such anatomical peculiarities as papillæ, hairs, &c., in certain plants as mechanisms for the perception of light and contact.

Individual variation in the development of plants is the subject of a paper, by Dr. K. Koriba, forming vol. xxiii., art. 3, of the Journal of the College of Science, Tokyo. Horse beans and peas were germinated and afterwards grown, some as water-cultures in tap-water, others in solutions containing zinc or copper sulphate, and others again in soil. Their development was estimated chiefly by the increase of length in stem and root. It is noted that these organs respond differently to changes in external conditions. Thus growth of the root continues at a lower temperature than growth of the stem, while at a higher temperature the reverse holds good; also a poisonous solution affects the root more readily. According to the observations quoted, heavy seeds do not always germinate most quickly, so that individual quality is considered to be more potent than weight.

The report for the year 1908 of the director of the botanic gardens and Government domains in Sydney has been received. There is special reference among native plants to a new variety of the shrub *Acacia salina* and the monocotyledonous plant *Aneilema gramineum*, related to Tradescantia. A number of the latest successful introductions come from South Africa, notably species of Aloe; these and species of Agave from Mexico appear to find the climatic conditions they require. Among the grasses, *Festuca arundinacea* and *Panicum muticum* are regarded as valuable species alike for fodder purposes and for decoration. A list of troublesome weeds includes *Allium fragrans*, *Cyperus rotundus*, *Hypochaeris radicata*, *Medicago denticulata*, and *Portulaca oleracea*.

A sketch of the flora of Siam is contributed by Dr. C. C. Hosseus to *Globus* (vol. xcvi., Nos. 10 and 11), where he describes the chief types of vegetation studied by him during several journeys into the interior. The country is rich in forests. An extension of the Indian sub-Himalayan pine forests, where *Pinus Khasya* is dominant, is found in the extreme north. There are luxurious evergreen forests containing oaks, laurels, species of Cinnamomum, Cephalotaxus, and Podocarpus at different altitudes, where lianes, ferns, and orchids grow in profusion. The teak forests seldom rise above 900 feet; the predominating teak is accompanied by *Albizzia procera*, *Butea frondosa*, and Xylia. The Dipterocarp forests growing on laterite also show a great wealth of vegetation. Below these formations occur the forests and grass lands of the Savannahs, while near the coasts the swamps provide habitats for Pistia, Salvinia, Azolla, Nymphæa, and Nelumbium. Finally, a mangrove belt lines the islands and coasts.

The North Carolina Department of Agriculture has issued an illustrated bulletin on some common birds of the farm, including the *bob-white* (*Colinus virginianus*), night-hawk or "bullbat" (*Chordeiles virginianus*), meadow-lark (*Sturnella magna*), and the various wood-peckers. Particular attention is directed to the food they take.

The first of the new series of scientific bulletins issued by the University of Wisconsin Experiment Station deals with the function of phosphates in the nutrition of animals. At least 3 grams of phosphorus were found to be necessary for a growing pig of 50 lb. weight, otherwise the animal withdrew from its skeleton both calcium and phosphorus in the proportions found in tri-calcic phosphate. In another bulletin, dealing with the phosphate contents of soils, we find the remarkable result that heavy manuring such as is practised in tobacco culture led to a great loss of phosphates from the soil. N/5 nitric acid proved a useful solvent in determining whether or not soils are deficient in phosphates.

The Proceedings of the Indiana Academy of Science contain reports of the papers read at the twenty-fourth annual meeting at Purdue University, Lafayette, Indiana. The president, Mr. Glen Culbertson, dealt with deforestation and its effects among the hills of southern Indiana. A report was also presented on the work of the pathological laboratory of the Central Indiana Hospital for the Insane, Indianopolis. Other papers dealt with local mycological problems, heterœcious plant rusts of Indiana, the rust of timothy, dissemination of disease by means of the seed of the host plant, and so on. There is an anthropological paper on the "shake" dance of the Quilente Indians, and a number of chemical and biological papers.

Attempts have been made to introduce into the West Indies from the United States new varieties of ground nuts, noted for the large size of the nuts and their heavy yield. The results have been somewhat disappointing, partly on account of the severe attacks of fungi. A description is given in a recent issue of the *Agricultural News* of the fungi already observed, but there are others still to be identified. One of the Uromyces has done a good deal of damage, and could not be kept in check by the ordinary remedies. Another fungus, not yet identified, attacks the roots. The diseased portions exhibit a fine web-like mycelium, covered in its older portions with straight, rod-like crystals. These form small white tufts, which grow somewhat, become yellow, and finally brown. They are about a quarter of an inch in diameter when fully grown, and roughly spherical in shape. In fruiting they show two or three layers of firm, brown hyphæ forming an outer covering which encloses a mass of swollen colourless hyphæ, complete but undifferentiated. They are probably of the nature of sclerotia. No other fruiting bodies have yet been found.

The Journal of the College of Agriculture, Tohoku Imperial University, Sapporo, Japan, contains a paper by S. Ito (in English) on the Uredineæ parasitic on the Japanese Gramineæ. Some 800 specimens were examined, collected from different parts of Japan, from Saghalien and the Kurile Islands in the north to Formosa in the south. They fall into six genera. Seventy-three species and two varieties are recorded for the first time in Japan, while no fewer than twenty-one are altogether new to science. The other paper, by Y. Niisima, contains a detailed description (in German) of the Scolytidæ injurious to forest trees. There is an enormous mass of detail in these papers, and the illustrations are very beautifully done; indeed, the publications of the Japanese agricultural colleges are beyond question the most beautifully illustrated of the agricultural journals.

THE current West Indian Bulletin (vol. x., No. 2) contains, as usual, a number of interesting articles on West Indian products. Among them is a statement of the present position of the cotton industry, showing a rapid increase in spite of one or two set-backs in a few unsuitable districts. The estimated value of the lint in 1902 was 7366*l.*; in 1907 it was 172,294*l.* A pamphlet is also issued summarising the experiments on sugar-cane at Barbadoes with seedling canes and with various manures. The striking result was brought out that potash and nitrogen manures increased the amount of sugar while phosphates diminished it. The Bulletin of the Jamaica Department of Agriculture, the second of the new series, is quite up to the standard set by the first, and contains an interesting article, by Mr. Ashby, describing the bacterial production of sulphuretted hydrogen from certain obnoxious ponds near Jamaica. There are also some well illustrated and interesting articles on the Indian cattle of the island and the Hereford herd of Knockalva.

AN interesting preliminary notice, by Mr. P. A. Curry, of the results obtained in the research of the upper air above the Blue Hill area during the rainy season of 1909 is published in the *Cairo Scientific Journal* for October last. The main object was to find the direction and velocity of the wind at different heights above Roseires by the use of small pilot balloons, of which seventy-nine were released. The surface wind, which was slightly west of south, veered to south-west at 1500 metres; at 3000 m. north-east winds were somewhat predominant, veering to slightly north of east at 3500 m. From that altitude to 6000 m. it was very constant in direction, at which point it backed slightly to north-east at 9000 m., then veering again to east at 12,000 m. One balloon which rose above this showed a due east wind at 13,000 m. and 14,000 m., veering to east-south-east at 18,000 m. Up to 3000 m. the velocity averaged little more than 5 metres per second, increasing to 10 m.p.s. at 6000 m.; it then decreased to 8 m.p.s. at 7000 m., and remained fairly steady up to 10,000 m. Above this altitude the velocity increased rapidly. The results show a fairly steady circulation whether rain falls or not, and the limiting height of the upper easterly drift does not decrease on dry days, as was found to be the case in Abyssinia.

DR. G. H. SAVAGE has sent us a reprint of the Harveian oration delivered by him before the Royal College of Physicians of London on October 18, 1909. Dr. Savage selects for the themes of his lecture experimental psychology and hypnotism, and emphasises the importance of taking into consideration the teaching and methods of these subjects with regard to neurological and mental pathology.

MR. B. A. GUPTE, assistant director of ethnography for India, has issued the preliminary draft of a collection of passages from the sacred books of the Hindus, Jains, Buddhists, and Mohammedans, dealing with women in India, their life, morals, character, rites, and ceremonies, which is of considerable interest. In a subsequent edition the compiler would do well to give definite references to his authorities, which would add considerably to the interest of the collection.

IN an article entitled "Mental Processes and Concomitant Galvanometric Changes" (*Psychological Review*, January), Dr. Daniel Starch investigates the changes in resistance of the body to a weak electric current during varying mental conditions. He concludes that all kinds of mental states are accompanied by galvanometric changes, and that emotional states and muscular activity produce the widest deflections, habitual activity and the process of visual attention producing the least. He finds that quiet mental activity, even when considerable effect is involved, produces only small galvanometric effects.

IN a note published in the Bulletin of the Imperial Earthquake Investigation Committee (vol. iii., No. 2, Tokyo) Prof. Omori considers briefly a subject already touched on by Mr. Oldham, namely, the dependence of the velocity of seismic waves on the nature of the path traversed by them. He calculates the mean surface velocity of the first preliminary tremors by the "difference method" for three earthquakes, and finds it to be 16·02 km. per second for the Guatemala earthquake of 1902, 11·36 km. per second for the Indian (Kangra) earthquake of 1905, and 13·97 km. per second for the San Francisco earthquake of 1906. In the first case the wave-paths were mainly submarine, in the second mainly continental, in the third partly continental and partly submarine. The differences in velocity may thus be due to a deficiency in rigidity in the continental portions of the crust (especially in the centre of Asia) and to an excess of rigidity beneath the Pacific and Atlantic Oceans.

THE Mines Department of South Australia has issued an interesting report, dealing with the mineral output of the State for the half-year ending June 13, 1909 ("A Review of Mining Operations in the State of South Australia during the Half-year ending June 30, 1909," No. 10, Adelaide, 1909). The chief mineral in South Australia is copper, produced from a large number of small scattered mines, but they were less active than usual owing to the low price of copper. There are many small gold mines, of which Arltunga is the most important field, but, owing to its inaccessible position, only very high-grade ores can be worked there. The average grade of the ore in the thirty small mines reported is 102*s.* per ton. The total quantity of ore treated from this field has been only 10,000 tons. Steady progress is being made with the phosphate mines, and a company is working one of the numerous deposits of high-quality china-clay found in South Australia.

IN the *Electrician* for January 7 Mr. Fournier D'Albe commences a series of articles on recent advances in electrical theory. The first instalment deals with the doubts which have been recently cast on the necessity for assuming an æther, with the principle of relativity, the Fitzgerald-Lorentz theory of the change of length of a body moving through space, and with the problem of aberration. The articles should prove a useful introduction to a subject which is one of the most interesting before the scientific world at the present time. There is a slight error in the statement of the amount of expansion of a rod which observers would postulate if the observed times of to and fro motion of light were the same with the rod at rest and in motion through the æther parallel to its length respectively. The amount of change stated by the author is that which would be postulated if the times were found the same when the rod moved with the same velocity with respect to the æther parallel and perpendicular to itself respectively, as in Michelson and Morley's experiments.

IN the December (1909) number of *Le Radium* M. Jean Perrin gives an account of his measurements of the Brownian movements in emulsions of gamboge and of mastic, and of the calculations of a number of molecular constants he has based on those observations. If it is assumed that the movements of the granules in such emulsions can be classed with those of the molecules of a gas, the theory of the equal partition of the energy amongst the molecules of mixed gases leads to the conclusion that the mean kinetic energy of translation of these granules is identical with that of gas molecules. If, then, the kinetic energy of the granules can be determined, the number of gas molecules in a cubic centimetre of gas under normal conditions may be calculated. M. Perrin determines the kinetic energy of the granules in two independent ways:—first, from measurements of the distribution of the granules at different heights in the emulsion, which he finds follows the same law as in gases; second, from measurements of the displacements of the granules in a given time, and the law which Einstein has deduced for the connection between displacement and mean kinetic energy. Both lead to the conclusion that the number of molecules in a gram molecule is $70{\cdot}5 \times 10^{22}$.

COMMENTING on the death of M. Delagrange, *Engineering* for January 14 points out two special features of technical interest in this aëroplane accident. In the first place it is the first fatal accident with a machine of the monoplane type, and, in the second, it is the first which appears to be distinctly owing to a failure in the main structure of the machine used. It seems to have been generally assumed that the biplane is a safer machine than the monoplane, yet the fact remains that the greater number of accidents have happened to the biplane. There seems to be good reason to suppose that the death of M. Delagrange was caused by the main framing forming one of the wings giving way altogether, followed by the fall of the machine. The general construction of the framing is that of a trussed girder constructed of wood and steel wire. The wires are very numerous in the biplane as compared with those required in the monoplane frame. Usually the wire stays are of solid steel wire or ribbon, which gives little indication of readiness to break. Stranded wire rope is better from this point of view, as ample warning is always given by some of the strands breaking before the rope finally gives way. The broken strands are very easily detected. Further, many machines of both types have the spars insufficiently stayed or not stayed at all against the longitudinal pressure due to the air resistance, which pressure in such cases will be taken up entirely by the spars. To make the aëroplane of practical use, trustworthiness and safety are required, and more attention should be given to these rather than to cutting down structural weights for the purpose of striving after "records."

THE December (1909) number of the *Journal of Physical Chemistry* contains a series of determinations, by Messrs. O. C. Schaefer and H. Schlundt, of the dielectric constants of the anhydrous halogen acids, which gave the following values:—

HI	21·7°, 2·90; −50°, 2·88; −70° (solid), 3·95.
HBr	24·7°, 3·82; −80°, 6·29.
HCl	27·7°. 4·60; −90°, 8·85.
HCN ...	−25° (solid), 2·4; −70° (solid), 3·05.

Attention may also be directed to a paper, by Mr. M. M. Garver, on a kinetic interpretation of osmotic pressure, in which the fundamental assumption is made that, whilst the average velocity of water-molecules in a sugar solution is the same as in pure water at the same temperature, the *range of variation* on either side of the mean is greatly reduced, so that vaporisation and freezing are alike rendered more difficult.

THE volume of the Journal of the American Chemical Society, which has just been completed, is remarkable, not only for the importance of the researches that are described in it, but also for the excellent conciseness with which the results are presented. Two papers by Mr. F. F. Rupert, on the properties of aqueous ammonia and aqueous hydrochloric acid, might be cited as models, not only of accurate and thorough investigation, but of successful resistance to the temptation to expand the bulk of the paper in proportion (or out of proportion, as the case may be) to the importance of the subject. The isolation of ammonium hydroxide, $(NH_4)OH$, and of ammonium oxide, $(NH_4)_2O$, is recorded, for instance, in a paper which covers less than three pages, and congratulations are due from the reader to authors and editor alike on the excellent results that have followed from their cooperation in this respect. The contents of the volume are of such a character as to give much support to the invitation that has recently been extended to English chemists to become members of the American society.

THE Institute of Chemistry has issued a third edition, revised and enlarged, of the "List of Official Chemical Appointments." The list has been compiled by Mr. R. B. Pilcher, registrar and secretary of the institute, and is sold at 2s. net. It is arranged in three main divisions:—appointments in Great Britain and Ireland, under the various departments of State, county and borough councils, and other authorities, together with professorial and teaching appointments in schools and colleges in this country; appointments in India and the colonies; and an appendix giving information regarding chemical societies and institutions. A register of fellows and associates of the institute who are seeking appointments is kept at the office of the institute, so that authorities may obtain the services of qualified professional chemists as vacancies arise. In many instances particulars are given in the list as to the Acts of Parliament under which appointments are made, and the regulations and conditions governing the selection of candidates for them. Intended primarily for the use of professional chemists, the publication should be found useful by authorities and persons interested in the applications of chemistry to purposes of State and in the promotion of higher chemical instruction.

A SECOND edition of Mr. G. M. Norman's "Systematic Practical Organic Chemistry" has been published by Mr. W. B. Clive at the University Tutorial Press, Ltd. Various alterations and additions have been made to the book in order to meet the new requirements of the Board of Education syllabus in the subject.

THE popular lectures to be given at the Royal Victoria Hall, Waterloo Bridge Road, S.E., on Tuesdays during February, include the following:—Mr. H. S. Rowell, on "Aëronautics"; Mr. Horace W. Monckton, on "Berkshire, Geological, Geographical, and Historical"; and Mr. E. Cuthbertson, on "The Constitution of Atoms."

COTTERILL AND SLADE'S well-known text-book, "Lessons in Applied Mechanics," has now been published by Messrs. Macmillan and Co., Ltd., in two parts. The first volume includes the sections dealing with the principle of work and hydraulics, and the second those concerned with the strength of materials and structures. The separate volumes meet the needs of students preparing for the various examinations in applied mechanics held by the Board of Education.

OUR ASTRONOMICAL COLUMN.

HALLEY'S COMET, 1909*c*.—A further extract from Mr. Crommelin's corrected ephemeris (*Astronomische Nachrichten*, No. 4379, p. 170) for Halley's comet is given below:—

Ephemeris for Greenwich Noon.

1910	R.A. h. m.	Decl.	log *r*	log Δ
Jan. 30	1 6·4	+ 8 27	—	0·2284
Feb. 4	0 59·1	+ 8 14	0·1916	0·2410
9	0 52·8	+ 8 4	—	0·2522
14	0 47·6	+ 7 58	0·1473	0·2617
19	0 42 6	+ 7 55	—	0·2688
24	0 38·1	+ 7 54	0·0971	0·2743
Mar. 1	0 34·0	+ 7 55	—	0·2774

These positions will be found plotted on the chart which we gave in our issue for January 13, p. 320, and it will be seen that the comet is now apparently travelling slowly westwards through the constellation Pisces; on February 5 it will be nearly 1° north of the 4·5 magnitude star ε Piscium. During February the comet's distance from the sun will decrease from about 151 to 108·7 million miles, whilst the distance from the earth will increase from about 157 to 176 million miles. According to the ephemeris given by Prof. Searle in No. 607 of the *Astronomical Journal*, the brightness should, during February, increase from 20 to 30, the unit taken being the brightness on September 11 when re-discovered. In the same journal Prof. Barnard gives some further observations, and states that on December 7 the comet was an easy object, appearing to have a small nucleus, in the 4-inch finder of the 40-inch telescope. In the latter it appeared much larger, and its magnitude was about 10·5.

In No. 4383 of the *Astronomische Nachrichten* (p. 238) Herr Archenhold describes the occultation of a twelfth-magnitude star by the nucleus of the comet on December 5, and, among other things, records that no appreciable change of the colour of the star was caused by the superposition of the comet; the nucleus was sharply defined, and by Argelander's method Herr Archenhold found that its magnitude was 11·8.

OTHER PERIODIC COMETS DUE TO RETURN THIS YEAR.—In addition to Tempel's second, and D'Arrest's comets, five other periodic comets may be picked up during 1910, and notes concerning them are given in No. 1, vol. xviii., of *Popular Astronomy* (January, p. 47).

Giacobini's comet, 1896 v., passed perihelion in December, 1909, according to the latest calculations, and its detection now is unlikely. Swift's comet, 1895 ii., is due at perihelion during the present month, but is unfavourably placed. Spitaler's comet, 1890 vii., is, according to the recent calculations of Dr. Hopfer (*Astronomische Nachrichten*, No. 4371), likely to pass perihelion early in October, and might, had a search been made, have been recovered in 1903; between 1897 and 1903 this comet suffered considerable perturbations by Jupiter, which lengthened its period from 6·42 to 6·82 years. Faye's comet is due at perihelion, in very favourable circumstances, in the latter part of October, and Brooks's comet, 1889 v., is more likely to be seen during the summer of 1910 than when near perihelion in January, 1911.

WINNECKE'S COMET.—In No. 4383 of the *Astronomische Nachrichten* Dr. Perrine states that Winnecke's comet will soon be too faint for him to follow with the 12-inch refractor at Cordoba. As it is moving northwards rapidly, he suggests that further observations may be secured with the larger instruments of the northern hemisphere. Dr. Hillebrand's ephemeris for this object appeared in No. 4374 of the *Astronomische Nachrichten*, and Dr. Perrine states that observations made on 1909 December 10 gave a correction (Obs.-Eph.) of R.A., −55s.; dec., 0′.

THE EPOCH OF THE LAST SUN-SPOT MAXIMUM.—In No. 12, vol. xxxviii., of the *Memorie della Società degli Spettroscopisti Italiani*, Dr. Wolfer discusses the epoch of the most recent sun-spot maximum. The observations show that the spot activity was maintained from 1905 to 1908, but, as there was a marked diminution in the latter year, continued in 1909, he concludes that the maximum is passed, and proceeds to determine its epoch. This is not a simple matter, because there were three marked waves, reaching their maxima in November, 1905, July, 1906, and February, 1907, respectively, and three smaller ones; in this respect the maximum strongly resembles that of 1829 and, less so, that of 1804. However, from the relative numbers Dr. Wolfer obtains 1906·1 as the principal maximum, and from the same data, compensated, 1906·4. This gives the interval from the preceding maximum as 12·3 years, 1·2 years in excess of the mean period 11·1 years. With regard to the intensity of the maximum, Dr. Wolfer finds that 1906·4 follows those of 1884 and 1894, making the third maximum of feeble intensity, and he discusses the observations made since 1750, showing that periods of great and small maxima follow alternately.

"ANNUARIO" FOR 1910 OF THE MADRID OBSERVATORY.—The annual publication of the Madrid Observatory is a substantial volume of 560 cap. octavo pages, and contains, *inter alia*, the usual calendars and astronomical tables, a dissertation on the nature, distances, motions, &c., of stars, and a *résumé* of the solar observations made at the observatory during 1908. The prominence observations are tabulated in detail, and then summarised in the form employed by Prof. Ricco. Meteorological results are also given.

A STUDY OF BARK-BEETLES.

THE entomological publications of the United States Department of Agriculture have for long past been the admiration of European naturalists. Exceptionally valuable, even among that Department's series of excellent memoirs, are two recent papers on Scolytid beetles of the genus Dendroctonus by Dr. A. D. Hopkins, one (Technical Series, No. 17, part i.) being in the main systematic and descriptive, the other (Bulletin No. 83, part i.) dealing for the most part with the bionomics of the beetles and the *rôle* played by the various species as depredators in North American forests. These papers contain some of the results of seventeen years' original research; probably no such descriptions and figures of the

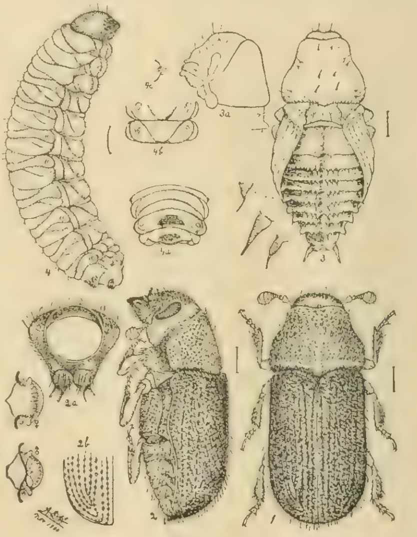

FIG. 1.—Eastern Spruce Beetle (*Dendroctonus piccaperda*). 1, Dorsal aspect; 2, lateral aspect; 2*a*, prothorax; 2*b*, end of elytron, showing sculpture; ♀, ♂, seventh abdominal terga of female and male (the clear oval spaces are stridulating areas; 3, pupa, dorsal aspect with spines more highly magnified; 3*a*, head and prothorax of pupa, lateral aspect; 4, larva, lateral aspect; 4*a*, terminal abdominal segments of larva, dorsal view; 4*b*, abdominal segments of larva, ventral view.

imaginal and larval anatomy of Scolytid beetles as those in the technical memoir have ever been issued before, while in the systematic portion are to be found, not only full structural accounts of the various species, but figures showing the characteristic form of the brood and larval galleries in each case. The accompanying figures, slightly reduced from the original, give some idea of Dr. Hopkins's excellent illustrations.

Most Scolytid beetles—the well-known *Hylurgus* (or *Myelophilus*) *piniperda*, for example—lay their eggs in dying or unhealthy trees or in felled trunks, the vigorous flow of sap and secretion of resin in healthy growing trees being unfavourable for the development of the larvæ. Members of the genus Dendroctonus, however, prefer, as a rule, healthy trees for breeding purposes; hence the destruction wrought by the insects may become exceedingly serious (see the photograph reproduced), and it is not possible to exterminate large numbers of the beetles and larvæ by "trap-trunks" or "trap-logs," according to the practice of German foresters with Hylurgus and similar bark-beetles. As is usual in American economic work, attention has been paid to the natural enemies of the destructive beetles, and experiments have been made with imported specimens of the handsome European beetle *Clerus formicarius*, which drags bark-beetles and larvæ from their burrows and ruthlessly devours them.

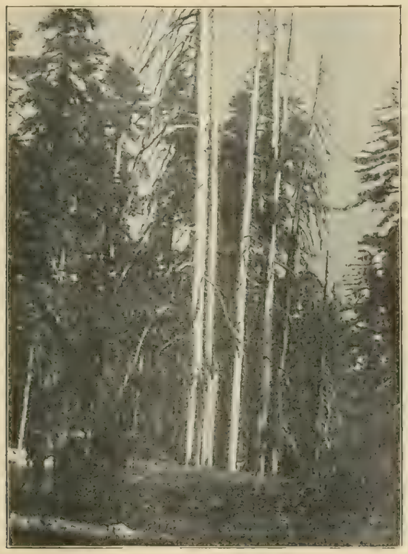

FIG. 2.—Yellow Pines killed by the Western Pine Beetle (*Dendroctonus brevicornis*), Yosemite National Park.

The genus Dendroctonus has a remarkable distribution. Twenty-three species are found in North America, the genus spreading northwards to Labrador and Alaska and southwards through the Mexican highlands into Guatemala. In the "Old World" a single species only is known—*D. micans*, which inhabits Russia, Germany, Denmark, and southern Scandinavia. While "the species of this genus of beetles are the most destructive enemies of the coniferous forest trees of North America," they are hardly known in Europe except to special students of the Scolytidæ. The absence of Dendroctonus from northern Scandinavia, from our own islands, and from western Europe generally, suggests that the former geographical connection between the outlying European *D. micans* and the numerous American members of the genus was by way of Siberia and Alaska.

G. H. C.

ATMOSPHERIC ELECTRICITY IN EGYPT.

IN Paper No. 10 of the Survey Department of Egypt Mr. H. E. Hurst discusses two years' results of atmospheric electric potential obtained from a Kelvin water-dropper electrograph at Helwan from March, 1906, to February, 1908. From observations made with a Kelvin portable electrometer, and experiments on the disturbing effect due to the presence of instrument and observer, a factor was obtained, multiplication by which transfers curve readings to potential gradient in the open (volts per metre of height). The mean value found for the potential gradient from the two years was 113, a value lower than is usually encountered in Europe. In the second year, however, owing to the more open scale employed, there was at times considerable loss of trace, and an allowance which Mr. Hurst makes for this would bring up the value of the potential gradient for that year from 119 to 129, and the mean for the two years from 113 to 118. The curves were not smoothed, and were measured only at the even hours, and there is rather excessive irregularity in the diurnal inequality curves which are given for individual months of the year. All show a prominent minimum in the early morning from 4 a.m. to 6 a.m., and some a secondary minimum in the early afternoon, but successive months differ in this respect rather widely. In the mean diurnal inequality for the year there is little variation in the potential from 10 a.m. to 10 p.m.; the value at 8 p.m. is the absolutely largest in both years. One very exceptional phenomenon is that the potential is decidedly highest in summer. The mean potential gradient from the four months June to September was 136, while that from the four months November to February was only 98, no allowance being made in either case for loss of trace. Curiously, however, the mean range of the diurnal inequality was 81 for the four mid-winter months as compared to 50 for the four months June to September.

The mean diurnal inequality for the year was analysed in a Fourier series. The amplitude of the 24-hour term was nearly double that of the 12-hour term. The latter term was found, as at Kew, to be almost exactly in phase with the 12-hour Fourier "wave" for barometric pressure. No connection could be found between potential gradient and temperature, sunshine, or any other meteorological element except wind direction and possibly vapour pressure. Other observers have associated sudden changes of potential with sunrise and sunset, but no such connection seems to exist at Helwan. During sandstorms negative potentials are sometimes encountered, but not always.

The present publication is welcome evidence of the scientific activity of the Helwan Observatory, and contains several results of much interest. It is to be hoped, however, that a more complete analysis will be made some years hence, when sufficient data have accumulated to give fairly smooth results for individual months of the year, and that the curves will then be measured at all hours of the day, and not merely at the even hours.

C. CHREE.

AMERICAN HYDROLOGY.[1]

NEGLECTING the quantity disappearing through evaporation as relatively insignificant, the rainfall over any area either finds its way on or near the surface into streams or percolates into the ground to form subterranean reservoirs, which are tapped in many cases, naturally by springs and artificially by wells. Each of these processes has a distinct and valuable bearing upon the industrial and hygienic resources of a country, and in countries where there is no separate hydrological service the scientific investigation of the national water supply comes within the purview of the geological department, as is the case in the United States. The two papers which form the subject of this brief notice illustrate in a very

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[1] Surface Water Supply of the United States, 1907–8. Part ii., South Atlantic Coast and Eastern Gulf of Mexico. Prepared under the direction of M. O. Leighton by M. R. Hall and R. H. Bolster. Water Supply Paper No. 242. Pp. 226.

Underground Water Resources of Connecticut. By Herbert E. Gregory, with a Study of the Occurrence of Water in Crystalline Rocks, by E. E. Ellis. Water Supply Paper No. 232. Pp. 200. (Washington: Government Printing Office, 1909.)

striking manner the varied and comprehensive character of the work carried on by the U.S. Geological Survey. The first volume constitutes a general review of the surface water supply over a very considerable tract of country, comprising the drainage basins of the rivers James, Roanoke, Yadkin or Pedee, Santee, Savannah, Ogeechee, Altamaha, Satello, St. John, Peace, Withlacoochee, Suwanee, Ocklockonee, Apalachicola, Choctawhatchee, Escamba, Mobile, Pascagoula, and Pearl; while the second is a comparatively local and complete investigation into the wells and springs of Connecticut.

An introduction to the former volume gives a brief *résumé* of the scope of investigations and the purposes of the work, with a description of the field methods employed for measuring stream flow, from which it appears that the system most generally in use is that of gauging by means of sectional areas and velocity readings. These last are taken by the Price current meter. Fig. 1 illustrates in a typical manner the plan of operations. At the selected station the river bed is divided transversely into any convenient number of points, at which records are taken both of the depth and the velocity. The latter is determined by two observations in each case, at one-fifth and four-fifths of the total depth respectively. The average of these two readings gives the mean velocity of the current very closely for open-water conditions. The discharge is obtained by a simple computation of the cross-sectional area of the strips multiplied by the average of the mean velocities at their ends.

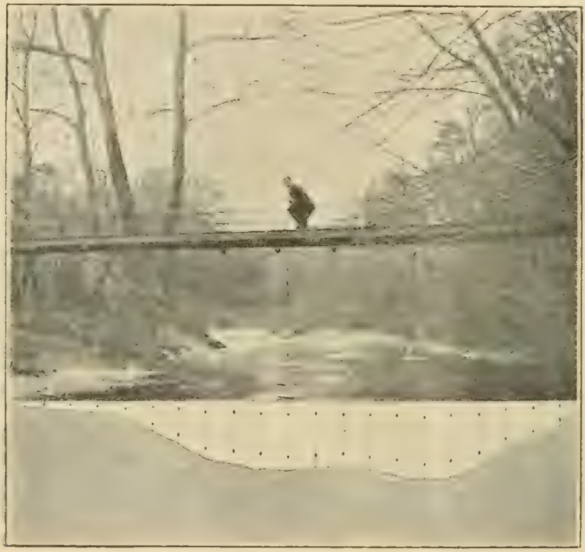

FIG. 1.—Bridge Station and Cross-section of Stream.

The second volume contains interesting chapters on the physiography, meteorology, and geology of the State of Connecticut, and not the least valuable feature is the study by Mr. Ellis of the conditions affecting the occurrence of water in crystalline rocks. The term crystalline is taken as covering both igneous (granite, diabase, gabbro, &c.) and metamorphic (schists and gneisses) varieties. More than two-thirds of the area of the State is underlain by rocks of this type, and a large number of wells have been driven into them. It is pointed out that the porosity of crystalline rock is very slight (averaging 0·5 per cent. or less), and that the only circulation of water which has sufficient rapidity of movement to be of value as a source of well supply must be through joints and fractures. A study of the occurrence of these joints, accordingly, is of great utility and value, and the data collected cannot fail to prove of more than local interest on account of the scarcity of information on the subject. B. C.

RECENT WORK OF GEOLOGICAL SURVEYS.

I.

GREAT BRITAIN AND INDIA.

THE wide range of work done by the Geological Survey of Great Britain is again seen in the "Summary of Progress for 1908" (1909, price 1*s*.). The numerous notes made on observations in England, Wales, and Scotland are, of course, only preliminary to their development in future memoirs; but we may here direct attention to the careful re-examination of two marine Devonian intercalations in the Upper Old Red Sandstone near Milford Haven (p. 35), and to the description of the Achanarras beds (Middle Old Red Sandstone) of Caithness, by Mr. R. G. Carruthers (p. 87). Caithness has also yielded a mass of sandstone with Lower Cretaceous fossils (p. 62). Even if this proves to be transported, like the blocks of chalk in Aberdeenshire, it will remain a remarkable addition to our knowledge of the extent of the early Cretaceous sea. The Petrographical Department has shown the presence of nepheline in several rocks of the Midland Valley of Scotland (p. 44).

The memoirs published recently include one of economic importance on the water-supply of Bedfordshire and Northamptonshire, with rainfall-maps supplied by Dr. H. R. Mill (1909, price 4*s*. 6*d*.). Dr. Strahan has written a second edition of the memoir on the country around Newport, in the South Wales coalfield (1909, price 1*s*. 6*d*.), which shows how knowledge advances, even during a decade. An interesting break near the top of the Carboniferous Limestone is pointed out, and the Old Red Sandstone is now divided into an upper and a lower series. It is probably not generally known that the characteristic Upper Old Red Sandstone mollusc, *Archanodon jukesii*, was found near Talgarth in 1895, the specimens being now in the British Museum. A terse and effective account is given on p. 89 of the passage from the continental beds of the Trias in this district through the Rhætic shales to the marine Jurassic system, and a comparison is made between this complete sequence and that observable where the Cretaceous sea spread across the Weald.

The description of the geology of the country around Basingstoke (1909, price 2*s*.), accompanying the colour-printed Sheet 284 (1*s*. 6*d*.), has been entrusted to Mr. H. J. Osborne White. The area is a familiar one, at the junction of the London Basin and the great swelling rolls of Salisbury Plain. The chalk district was formerly strewn with sarsens, which have been traced to a sandstone in the Reading beds. The Plateau Gravels raise interesting questions of former river-courses, and it appears that the Wey basin (p. 90) has now captured waters that once brought Lower Greensand débris westward into the valley of the Loddon. The soft Eocene strata are responsible for considerable "mutability of the lines of drainage."

The memoir on the country around Bodmin and St. Austell, by Messrs. Ussher, Barrow, and MacAlister (1909, price 4*s.*), accompanies the colour-printed map, Sheet 347 (price 1*s.* 6*d.*). The tin and copper mines are described, with sections. Considerable interest attaches to the origin of china-stone and china-clay (p. 105); the former is an altered granite, in which kaolinisation is not an essential feature. It must not contain tourmaline, or minerals liable to discolour it. China-clay, on the other hand, must be a kaolinised product, and tourmaline can be washed out of it during its preparation for commercial use. Mr. MacAlister (p. 115) attributes the main kaolinisation to "moisture with fluorides emanating from the granite," while Dr. Flett (p. 118) believes in the greater potency of carbonic acid. Hence we are by no means at the end of this much-discussed question. The metamorphism of the Devonian rocks by a granite associated with the Hercynian folding furnishes interesting material. We wish that Mr. Barrow could have been restrained from promulgating the Anglo-Swedish word "calc-flinta" (p. 99), which can hardly be taken as a serious term. It appears, however, on the index to the map, where it has become classed, with associated altered sediments, as of igneous origin.

The Scottish branch of the Survey recalls the ancient state of things, when romance and argument by flood and field were to be sought northward of the Tyne. The memoir on Sheet 45, including Oban and Dalmally (1908, price 2*s.* 6*d.*), has for its frontispiece the Pass of Brander, through which the Atlantic always seems to call, across the rain-swept moorland under Cruachan. Mr. H. Kynaston, before his departure for the Transvaal, surveyed this region with Mr. J. B. Hill, and several other authors have joined in the present memoir. Much of the interest of the area is petrographical, but nowhere is the petrographer more dependent on the relations of the rocks as determined in the field. Take, for instance, the marginal features of the Cruachan granite (p. 83), or the pitchstone with cordierite, augite, magnetite, and spinel (p. 129), which results from the fusion of a phyllite by a Cainozoic dyke. Bibliographers should be warned that one of the authors of this memoir, Mr. H. B. Muff, changes his name henceforward to the ancestral form of Maufe. Under this guise he appears as joint author with his colleagues, Messrs. Clough and Bailey, of a very striking paper on the Cruachan and Glen Coe cauldron-subsidence, in the Quarterly Journal of the Geological Society for November, 1909. It is not too much to say that the researches of the Geological Survey have added to our appreciation of one of the grandest regions of the Highlands.

The memoir on Sheet 36, covering the seaboard of Mid-Argyll, is mainly by Messrs. Peach, Kynaston, and Muff (1909, price 2*s.* 3*d.*). Effective illustrations are given of the remarkable boulder-beds traceable above the limestone-zone of the metamorphic series. The reality of the break marked by this conglomerate is shown by its frequent inclusion of local rocks, such as the limestone blocks in the Garvellachs. Rocks from unknown sources also occur. The chapter (p. 43) on the epidiorites of the area, and on their origin as "pillowy" basic lavas, will be of value to geologists in many countries who have to deal with this group of modified rocks, in which a similarity of character has been thrust on materials of very various modes of upbringing. The slate quarries of Easdale have been studied in their economic aspect, and Mr. Muff contributes (p. 16) a valuable exposition of the relations of the various parting-planes to the folding of the rocks, which is applicable to many other cases difficult of interpretation, even in the field.

The Records of the Geological Survey of India contain evidence of a great variety of observations, ranging from economic materials to fossil remains. In the mineral field Dr. Bleeck deals with jadeite, which is extensively worked in a dyke or in detrital boulders by Chinese enterprise in Upper Burma (vol. xxxvi., p. 254). He concludes that pure jadeite consists of the (metasilicate) $NaAlSi_2O_6$, and that the dyke in the Kachin Hills originally consisted of nepheline, $NaAlSiO_4$, and albite, $NaAlSi_3O_8$. One molecule of each of these would produce paragenetically two molecules of jadeite. Albite occurs in both margins of the dyke, as is shown in the interesting section on p. 276, and these marginal zones contain blocks picked off from an adjacent amphibolite. It is presumed that the original magma was unusually rich in soda. Mr. Fermor (vol. xxxvi., p. 295) verifies by new analyses the view of Laspeyres, that psilomelane is a definite manganate of manganese, barium, iron, potassium, and hydrogen, based on the acid H_4MnO_5. Hollandite is crystallised psilomelane, while coronadite of Arizona is held to be a form in which barium is replaced by lead. Mr. P. N. Bose's account of the mineral resources of Rájiplá (vol. xxxvii., p. 167) describes the carnelian mines of Ratanpur, which have been worked for 400 years. The stones are coloured by heating on the spot. The date of Mr. Copland's report is not given, but we judge it to be about 1830. At that time the miners walked seven miles to the mines and seven miles back every day, "on account of the tigers with which the country abounds." In the same volume (p. 199) Mr. Fermor describes three new manganese minerals from India, vredenburgite, probably $3Mn_3O_4.2Fe_2O_3$, and highly magnetic; sitapárite, $9Mn_2O_3.4Fe_2O_3.MnO_2.3CaO$, with a bronzy colour distinguishing it from braunite; and juddite, a manganese amphibole. Specimens of all these may now be seen in the British Museum collections.

In physical geology we note Mr. J. C. Brown's description of the mud-volcanoes of the Arakan coast, Burma (vol. xxxvii., 1909, p. 264), which are produced by the bursting up of petroleum vapours, and which occasionally build up temporary islands in the sea. Sir T. H. Holland and Mr. W. Christie furnish an important paper on the origin of the salt-deposits of Rajputana (vol. xxxviii., 1909, p. 154). They show, in the first place, that the rivers flowing into the basins in which the salt accumulates in dry seasons contain an unusual amount of sodium chloride; secondly, that this is not likely to be washed out of older salt-beds; and thirdly, by actual experiments at Pachbadra, that the amount of salt passing a front 300 km. broad and 100 m. high during the four hot-weather months is some 130,000 tons. Mr. T. D. La Touche suggested in 1902 that the salt in the great plains might be added to by wind-borne drift, but the present writers conclude that this is the essential method of supply. The Rann of Cutch becomes actually crusted over with salt in the dry season; magnesium and potassium salts, being more soluble, are left behind in the unevaporated water (p. 168), and the sodium chloride, probably with gypsum, is carried inland. Small Foraminifera have been blown inland from the Cutch coast for 500 miles. The rains follow on the hot months, and the salt is washed into temporary lakes before it can be blown back by the return monsoon. The application of this striking instance to the Triassic lake-basins, formed under desert conditions (p. 183), makes it of wide importance. Judging from the immense stretches of pebble-beds in the European Trias, and from the signs of extension and recession of the lakes, flood-waters arising under monsoon influences may have prevailed in a region that was dry during a large part of the year. Gypsum beds like those of our Trias are found deposited from the seasonal lakes of north-west India.

Stratigraphy is represented by Mr. G. E. Pilgrim's investigation of Tertiary fresh-water deposits in Baluchistan and Sind (vol. xxxvii., p. 139), in which he divides up beds previously grouped as Siwalik into an Oligocene series with Anthracotherium and the allied Brachyodus, an Upper Miocene series with Deinotherium and Tetrabelodon, and an unfossiliferous series, which is probably Upper Pliocene. Unconformities occur between these series. Mr. C. S. Middlemiss, writing on the Gondwanas of Kashmir (vol. xxxvii., p. 286), suggests a re-arrangement of beds previously studied. He has found a new Lower Carboniferous horizon in the Lidar valley (p. 319), lower than the Panjal volcanic series. Above the Panjal series on the Golabgarh Pass he traces a section where Lower Gondwana plants (Gangamopteris, Glossopteris, &c.) lie beneath marine beds with a Middle Carboniferous fauna. This establishes (p. 296) the position of the Lower Gondwana beds in peninsular India, including the Talchir glacial series. No signs of glacial conditions, however, were observed in their representatives in the north. Mr. E. W. Vredenburg, in a paper on a hippurite-limestone in Seistan (vol. xxxviii., p. 189), points out that Seistan occupies a tectonic depression, the floor of which has been covered by the lacustrine Pliocene Gobi formation, the equivalent of the Siwaliks of India. This has been covered by later alluvium, but appears, highly inclined, on the margin of the basin, and earth-movements have probably continued into Pleistocene times.

Following on Mr. Yabe's recent review of the genus Fusulina, particularly in its Asiatic bearings, which was noticed in a previous article in NATURE, Mr. H. H. Hayden adds a critical and microscopic investigation in a paper on Fusulinidæ from Afghanistan (vol. xxxviii., p. 230). He shows good reason for the view that Fusulina is perforate, but urges that the appearance of its shell, and its minutely granular character under the microscope, should place it among the porcellanea. It does not appear, however, that the fossil porcellanea selected for comparison are in their original condition, seeing how quickly a granular calcitic structure arises in shells that were once composed of aragonite. Mr. Hayden regards the shell of a modern Biloculina as also similar, and as composed of calcite (p. 233). In the face of other determinations it will be well to suspend judgment before Fusulina becomes placed in a unique position.

In Palæontologia Indica, also published by the Indian Geological Survey, Dr. A. S. Woodward (vol. iii., Memoir 3) has described fish-remains from the Lameta beds of the Central Provinces, which fix the age of these beds between Danian times and the close of the Eocene period.

The Mysore Geological Department (Bulletin No. 4) has assisted the gravity observations of the Survey of India by the determination of the densities of a large number of specimens of hornblende schists obtained from mine-shafts nearly 3000 feet in depth. The unaltered rock, where it is below the zone of saturation by water, has a density of 3·00. The effect on the superficial zone of alternate wetting and drying in a tropical atmosphere is shown by its being regarded as "weathered" down to 100 feet, the density in the first 10 feet being 1·65, inclusive of air-spaces, and rising to 2·66 at 30 feet and 2·90 at 100 feet. The determinations give what are styled "apparent specific gravities" in soil-analysis, and the method of collection of the loose material in its field-condition in a measured box might have proved simpler than that actually adopted (p. 9). In vol. viii. of the Department's Records (for July, 1906, to June, 1907, received in November, 1909), Mr. B. Jayaram makes the now customary complaint (p. 84) that his oldest rocks in Mysore are hornblende-schists, into which gneiss, and subsequently pegmatite, have intruded. He presumes below this "an hypothetical archæan basement rock, say gneiss," but this is probably suggested out of deference to the text-books. His notes on rocks and minerals express a large amount of original observation, and he claims a secondary origin for his pyroxene-hornblende granulites (p. 99), without realising that he is thereby bringing them into line with those of Saxony, the nature of which was so long misunderstood. According to Dr. Smeeth, the State geologist (p. 15), there is a good deal to be yet learned about the origin of the Mysore laterites; but Mr. H. K. Slater's report on the Sorab Taluk (p. 31) has suggestive remarks on the relation of laterite to lithomarge, and of lithomarge to an original highly felspathic granulite, elsewhere referred to as a banded felsite or rhyolite. He believes that the same granulite (p. 49) passes, by impregnation with silica and iron oxide, into a brecciated chalcedony-hæmatite rock, which has been described, somewhat misleadingly, as a quartzite. This paper needs some press-correction.

The Reports of the Mineral Survey of Ceylon for 1907 and 1908 include the last work of Mr. James Parsons, whose tragic loss is recorded in that for 1908. Considerable attention is given to thorianite, and the monazite of Ceylon has yielded 10 per cent. of thoria. "Reconstructed" rubies, as well as beautifully cut gems of a glass rich in lead and thallium, are now being sold in Ceylon markets. Western science has much to answer for in the east. The useful relations between the Survey and the Imperial Institute in London are clearly seen in these reports, and the same feature is apparent in the Geologists' Annual Report of the Federated Malay States for 1908, in which tin-deposits are naturally of foremost interest.

G. A. J. C.

EDUCATION ABROAD AND IN ENGLAND.[1]

IN education, as in other matters, each nation must solve its own problems for itself. Every system of education should be the expression of national characteristics and adapted to national idiosyncrasies. Still, lessons which we can ill afford to neglect may be learnt from the study of developments in other countries, and in some respects it is much easier to ascertain what is being done abroad than at home. Thanks to the admirable series of special reports inaugurated by Prof. Sadler, we can make ourselves more or less familiar with the details of foreign education. With regard to England, we are not so fortunately situated; the Board of Education gives little or no information as to new and successful experiments, and its reports have mainly a statistical value. This lack of information as to the progress within recent years renders a comparison between English and foreign systems difficult and misleading.

Attention is commonly concentrated upon Germany and the United States. This is natural, having regard to their extraordinary industrial development during the past generation and the extent to which it may be attributable to their systems of education. With regard to Germany, it would be remarkable if a nation forced to repair the ravages of war by intellectual effort—you remember Humboldt's famous expression in 1807, "Der Staat mus durch geistige kräfte ersetzen was er an physischen verloren hat"—had not in the course of a century become pre-eminent in one or more departments; but when you test the value of the system you will find, I think, that the general balance is in our favour. The facilities for technical and scientific instruction are as great here as there, but where the German has the advantage is in the better quality of the pupils who attend those colleges and schools. This is entirely due to the excellence of their secondary education, and until we can make the Board of Education and the public realise that prolonged and sound general education is the essential antecedent to successful technical and scientific training, the quality of the material supplied to our technical and scientific institutions will remain inferior. By their regulations, the Board of Education seem hardly to appreciate the supreme importance of this. A course of four years compares most unfavourably with the courses at the Gymnasia and Realschulen, and it is a fatal mistake to allow that course to be shortened in any circumstances, or to permit individual pupils or special classes to follow a curriculum varying from the curriculum approved for the rest of the school. To remedy the glaring defects in our system of secondary education, and to place our pupils upon terms of equality with those in Germany, it is imperative to fix a higher standard and strictly to adhere to it.

Of the United States as a whole it is difficult to speak. Each State has its own system, and the only common characteristic is the lavish expenditure upon buildings and equipment. No one is more conscious than the American himself that the results are far from satisfactory.

In spite of this, however, valuable lessons may be learnt from America. We are indebted to them for the promotion of international congresses, which will be of universal benefit if they only succeed in the standardising of university education, which at present leads to endless misapprehension and confusion. We might, too, with advantage imitate their custom of holding frequent local inquiries with a view to the re-adjustment of existing methods so as to satisfy modern requirements. At the same time, they have done much to solve the problem of the connection between instruction and apprenticeship, the workshop and the school. The fundamental principle there is based upon the rational assumption that the proper and only way for a young man to learn the practical side of his profession, together with business details, is by working as a regular employee, and that the only place where he can learn properly the scientific and the cultural subjects is at a school under trained teachers. We need also a bureau of education as well organised and endowed as that at Washington to act as an imperial centre for information and advice.

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[1] From a paper read at the North of England Education Conference, Leeds, on January 8, by John C. Medd.

For purposes of effective comparison, it may be well briefly to indicate the acknowledged gaps and apparent defects in our system, and the possibility of remedying them by the adoption of particular types of school and methods of instruction from other countries. It is by such an eclectic process that the Japanese are transforming themselves, and have gradually built up a system of education which, upon paper at least, leaves little to be desired. Notwithstanding the constant criticism levelled against the ancient universities and great public schools, I do not consider that they fail to realise their respective functions.

It is with reference to the ordinary secondary schools that the position is so unsatisfactory, and for their improvement we must, as I have already intimated, learn from Germany, or Holland, the burgher schools of which furnished the Germans with their models. Simultaneously, the facilities for promoting the easy passage of suitable pupils of all ranks from one type of school to another ought to be increased.

In elementary education as a whole we stand unrivalled, with the possible exception of Holland, where the methods of instruction are still as Cuvier described them, "au-dessus de tout éloge." It would be folly to expect the same standard of excellence in all schools, having regard to the infinite variety of conditions under which each school is conducted. The great need, commonly, is for more practical instruction, some relaxation of the regulations as to building and equipment for manual instruction and domestic science, and the introduction of a system of supplementary courses. We require, as Prof. Sadler has pointed out, a new type of school in which less attention is paid to purely literary subjects and more to the practical side.

The teacher is the most important factor. Upon his character, capacity, and sympathy the quality of each school depends far more than upon the public spirit of the local authorities and managers. His training is still too limited and hampered by the exigencies of the certificate examination. The normal schools of both France and Holland are conducted on far more enlightened principles. It is recognised that there are certain subjects, such as the theoretical and practical study of natural and physical science, which every teacher, whether destined for an urban or a rural district, ought to know. We do not want to create two distinct classes of teachers or to establish separate institutions for those who will have charge of country schools, but we do want the student during his period of training to become qualified to discharge all those duties which are involved in the modern conception of an elementary school. In Holland, for instance, every student has a systematic course of instruction in horticulture and the elementary principles of agriculture. In woodwork every student makes a complete set of the models of the Swedish Slöyd system and of objects required for other lessons, such as chisels, rulers, levers, and scales; models of tools or engines to assist in explaining different trades and industries; implements for the manufacture of linen and lace, &c. In addition, each student constructs an aquarium, terrarium, and a case for insects to be collected and attended to by himself. Beyond acquiring a mass of information invaluable to him in his profession, he learns how to make the apparatus necessary for object-lessons in the primary school.

The outstanding blot upon English education is the absence of any adequate provision for those who have completed the elementary-school course but do not proceed to a secondary school. To expend millions upon these children until the age of thirteen or fourteen, and then to turn them over to the education of the streets, is disastrous from every point of view. It is during the period of adolescence that the habits are formed which will determine the boy's or girl's whole future career. Cast adrift as they are in the vast majority of cases to rely upon their own resources, they constitute a grave social danger, swell the ranks of the unemployed, and gravitate to the workhouse or the gaol. It is computed that only one in six between the ages of fourteen and twenty-one are receiving any systematic instruction. Taking those between fourteen and eighteen, 2,000,000 out of 2,800,000 have done with education altogether. Minister after Minister of Education deplores this, but no practical steps have ever yet been taken by any Minister to remedy the evil.

Continuation schools, however, are not alone sufficient. A few trade schools have been established, but they should be the rule, and not the exception. The Ambachts or trade schools of Holland furnish a good example. Those admirable institutions owed their origin to private or local initiative, but are subsidised and inspected by the Government. The course usually lasts for three years, and the instruction is continuous throughout the year. The subjects naturally depend to some extent upon local circumstances, but generally include drawing, geometrical drawing, physics, mathematics, mechanics, wood and metal work, all taught technically and with the view of particular industries. In some cases instruction is also given in masonry, furniture and instrument making, painting and house decoration. The results are undoubtedly excellent. For some time artisans were a little jealous of this trade instruction, but now there is an increasing demand by them for lads who have completed the school course. It is intended that pupils should proceed direct from the primary school at the age of twelve or thirteen, and this is the usual custom. A few boys occasionally attend after leaving the intermediate schools or the gymnasia.

Now that the Board of Education has substantiated its claim to be the responsible authority for agricultural education, it would be wrong to ignore that question altogether. We are as far behind other nations in that respect as in the training and instruction of children when they leave the elementary school. In proportion to the agricultural population we have a greater number of advanced colleges than are to be found in any country, but for the rank and file of young farmers and smallholders facilities for acquiring that knowledge which today is essential to the successful cultivation of the soil can hardly be said to exist. We are constantly reminded of the agricultural prosperity of Denmark, but it is generally forgotten that that prosperity is due to the excellence of the people's high schools, which impart a sound secondary education, and which are free from any agricultural bias. The attempt to combine agricultural teaching with general education was quickly discarded by the Danes. What we require are winter schools and classes corresponding to those in Ireland and Holland, a few practical schools of agriculture of the type of those in France, and farm institutes of the character recommended by Lord Reay's Departmental Committee.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Dr. Robert Simon has been elected to the chair of therapeutics rendered vacant by the death of Prof. Foxwell.

Prof. J. W. Taylor has resigned the chair of gynæcology.

Mr. E. E. Fournier d'Albe has been appointed assistant lecturer and demonstrator in experimental physics to fill the vacancy caused by the resignation of Mr. F. W. Aston, who has accepted a post as assistant to Sir J. J. Thomson at the Cavendish Laboratory.

Mr. George Heaton has been appointed lecturer in operative surgery, and Dr. Edgar P. Hedley has been elected to a demonstratorship in chemistry.

Prof. Bostock Hill has been asked to act as a delegate to represent the University at the Congress of the Royal Sanitary Institute to be held in Brighton in September, and also at the International Congress on School Hygiene which meets in Paris in March next.

Prof. F. W. Gamble, F.R.S., has been appointed to represent the University at the eighth International Zoological Congress at Graz (Austria) in August.

CAMBRIDGE.—The Public Orator, Dr. Sandys, spoke as follows in presenting Dr. Mark Aurel Stein for the degree of Doctor of Science *honoris causa* on January 20:—

Adest vir scientiarum non minus quam litterarum de finibus proferendis bene meritus, qui Hungariae in urbe maxima natus, et inter Tubingenses Oxoniensesque linguis orientalibus eruditus, in imperio nostro inter Indos iam per annos plurimos scholis et collegiis nostris administrandis non sine laude praefuit. Ibi, tot laboribus occupatus, tempora tamen subsiciva (ut aiunt) fluminis Indi regionis montanae annalibus antiquis diligenter edendis et luculenter illustrandis non sine fructu dedicavit. Ibi, tot laborum per intervalla, itinera illa magna, Indiae proconsulis magni auspicio, est aggressus, unde gloriam maximam merito est adeptus. Olim, ultra Indiae terminos in regiones propiores prospere peregrinatus (ut alia praeteream), petram Aornon accuratius investigandam esse duxit, rupem illam praecipitem et abruptam "ab Hercule frustra obsessam," ab Alexandro post pericula plurima captam et Minervae Victoriae consecratam.[1] Idem viatoris antiquissimi vestigiis sacris ingressus,[2] Asiae in ipsa penetralia plus quam semel peregrinatus est. Illic, itinere longinquo in uno, regionis desertae ex arenis, quot "oppidum cadavera"[3] diu sepulta, quot tabellarum litteris priscis inscriptarum reliquias, per saecula longa quam tuto conservatas, eruit! In altero autem, regionem quam immensam minutissime permensus, quot tabulis pictis domi delineandam tradidit! Quot turres diu desolatas, quot imperii Sinensis olim latius porrecti propugnacula, dinumeravit! Quam ingentem librorum in quanta linguarum varietate scriptorum multitudinem, quam multa denique artium Graecarum, artium Asiaticarum monumenta, aut pictoris aut sculptoris manu antiquitus exornata, Britanniae in Museum maximum victor reportavit! Herculis praesertim et Minervae et Amoris imagines, olim gemmis insculptis in creta impressas, ab eodem inventas recordati, confitemur inventori tam strenuo, tam sagaci, tam amabili, neque Herculis fortitudinem virtutemque, neque Minervae prudentiam, neque Amorem ipsum, scientiarum et veritatis amorem incorruptum, defuisse.

Duco ad vos Asiae exploratorem impigrum, prudentem, perdoctum, virtutis antiquae exemplar bene nominatum, Marcum Aurelium Stein.

Mr. R. C. Punnett, superintendent of the Museum of Zoology, has been elected to the professorship of biology recently vacated by Prof. W. Bateson. Mr. Punnett took his degree in 1898, obtaining a first class in part ii. of the natural sciences tripos. He was awarded the Walsingham medal in 1900. He has also received the Thruston medal. For some time he held the Balfour studentship, to which he was elected in 1904. He succeeded Dr. Harmer as superintendent of the Museum of Zoology at the beginning of last year.

Prof. W. Bateson, who vacated an ordinary fellowship at St. John's College on resigning the professorship of biology, has been elected to an honorary fellowship.

The chairman of the special board for anthropology gives notice that Mr. Roscoe will give a course of lectures during the present term on the natives of Uganda. The lectures will be given on Fridays (commencing on Friday, January 28), at 5 p.m., in the lecture theatre of the Archæological Museum.

THERE is about to be introduced into Congress a Bill "to promote health and efficiency by the establishment in the United States Bureau of Education of a division for the collection of scientific data on physical education and for the dissemination thereof." The proposal originated at a recent convention of the National Education Association, which appointed a committee to direct the attention of Congress to the need of governmental action on the subject. The association emphasises especially the growing importance of physical culture in view of the increased tendency to the congestion of the population of America in cities.

THE first meeting of the newly formed London branch of the Mathematical Association will be held at the Polytechnic, Regent Street, on Saturday, January 29, at 2.45 p.m. Mr. A. W. Siddons (Harrow) will read a paper on the Board of Education circular on the teaching of geometry, and amongst those who will contribute to the discussion are Miss Home, Miss Gwatkin, Mr. G. St. L. Carson, Dr. T. P. Nunn, Mr. J. G. Hamilton, Mr. F. J. G. Whipple, and Mr. T. J. Garstang. There will be an exhibition of books and models. Those desiring to attend are requested to communicate with the honorary secretary, Mr. P. Abbott, 5 West View, Highgate Hill, N.

ACCORDING to the *Madras Educational Review*, Sir F. D. Lugard, the Governor of Hong Kong, has reported to the Government that Mr. H. N. Mody has offered to present the colony with the building necessary to start a university. A committee has been formed, with the Governor as chairman, to promote the undertaking. Mr. Mody's original offer was to give a sum of 30,000*l.* for this purpose, and a further 6000*l.* towards the endowment. Plans of the necessary buildings were prepared, and as the Director of Public Works estimated that the cost would not be less than 58,000*l.*, Mr. Mody undertook to provide them in accordance with the plans which he had approved, no matter what the cost might be, stipulating, however, that he should use on the buildings the 6000*l.* originally given for endowment if it should be required.

A COPY of the report of the principal of the Huddersfield Technical College for the session 1908–9 has reached us. The number of students in attendance during the session amounted to 1593, an increase of 106 over the previous year. The principal directs attention to the urgent national and civic importance of an early attempt to remedy by legislation the defects in our present system of public education. He points out that, after passing through the standards in the primary schools, most of the nation's children are cast adrift upon the world untouched by any educational influence, the great majority before they reach the age of fourteen, and many thousands before they are thirteen. There are in England and Wales more than 1,500,000 boys and girls below the age of seventeen who are not in attendance at any school, whether day or evening, primary, secondary, or technical. It is to be hoped that the need for the continued educational oversight and care of this army of adolescents will be recognised by our legislators speedily. Half-time labour below the age of fourteen, he insists, must be abolished, and the school-leaving age raised to fourteen at least, while some beginning should be made in the work of providing for the continued instruction of those children who at present escape from all educational supervision on leaving the day school.

THE *Builder* for January 15 has an illustrated article on the accepted design for the City of Leeds Training College. The portion of the estate of Kirkstall Grange, Far Headingley, near Leeds, which is to be utilised measures seventy acres in extent. The major portion has been purchased from Lord Grimthorpe, and about thirty acres have been leased for seven years. The existing house, a fine example of eighteenth-century work, is very wisely to be retained in the scheme. A finer site could hardly have been obtained. The scheme of buildings comprises educational block; five hostels for women and two for men, in addition to the existing mansion, which is to be utilised as a hostel for men; baths and laundry; sanatorium; principal's and vice-principal's houses; women's and men's games pavilions, together with the requisite lodges. Sir Aston Webb, as assessor appointed by the committee, placed the design of Mr. G. W. Atkinson first. The front elevation of the educational block in this design consists of a centre and two end pavilions connected by wings; crowning the centre, where a recessed portico of the Corinthian order standing on a basement is employed, is a low dome. The whole composition has an air of Georgian refinement which accords well with Kirkstall Grange, and the scheme, when translated from paper to reality, will make the educational apparatus of Leeds Education Committee as nearly perfect as is possible in the present state of our knowledge.

THE Maharaja of Durbhanga, presiding at the end of December last at the Lahore Industrial Conference, spoke of the industrial activities of India. The *Pioneer Mail* reports him to have said that the first and foremost of all Indian industries is agriculture. Agriculture is receiving the serious attention of the Government. Agricultural colleges and Government farms planted here and there have been doing fruitful work so far as they are able, but there are not enough of them yet to do more than touch the fringe of the subject. Scientific agriculture must begin to be taught and learned at all the primary schools in India, every pupil being practically instructed by means of gardens attached to each school. The agricultural education of the people must be put in the foreground of the endeavours of the Government and of all the educational authorities. Experiments at the Government farms have shown that with selected seed and proper treatment an acre can be made to yield, on an average, from 50 to 100 per cent. more than it does at present. To take an instance, the average output of wheat in India is only from nine to ten bushels per acre. In Great Britain it is more than thirty. To raise the average in India even to fifteen bushels is surely not beyond the reach of science. The same remarks might be made in regard to all the food crops. An attainable 50 per cent. more, when realised, would go far to banish scarcity and famine from the land.

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[1] Curtius, viii. 11, 2–24.

[2] A reference to Hiuen-Tsiang, the great Chinese pilgrim of 649 A.D. whom Dr. Stein claimed as his "guide and patron-saint" ("Sand-buried Ruins of Khotan," ed. 1904, p. xxi., &c.).

[3] Ap. Cic. *ad Fam.*, iv. 5, 4.

Prof. Rudolf Tombo, jun., of Columbia University, contributed to *Science* of December 24 last an article dealing with university registration statistics in the United States. The returns are given for twenty-eight of the leading universities, three institutions having been added to the list this year, viz. Texas, Tulane, and Washington (St. Louis). In 1909 four universities—Iowa, Minnesota, New York, and Yale—showed a loss in enrolment compared with the previous year, as against two universities in 1908 and five in 1907. On the whole, there were considerable gains, the increase in several instances being quite marked. The greatest gains were made during the year by Columbia, Chicago, Wisconsin, California, Cornell, Ohio, and Pennsylvania, in the order named, each one of these having gained more than 300 students. Columbia was the only university to register an increase of above 400 students in 1909, whereas there were no fewer than eight in 1908. For the second time in the history of American universities the 6000 mark was exceeded, Columbia having a total enrolment in 1909 of 6132 students, Harvard having registered 6013 in 1903. Harvard continues to lead in the number of male academic students, being followed by Yale, Princeton, Michigan, Chicago, Wisconsin, Columbia, and Minnesota. A general depression occurred in the case of the engineering schools, Stanford being the only institution to exhibit a noteworthy gain. The important schools of agriculture showed an increase, the single exception being Minnesota. The article concludes with an individual examination of the statistics of the more important of the universities.

SOCIETIES AND ACADEMIES.

London.

Royal Society, January 20.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. C. **Bolton**: Further observations on the pathology of gastric ulcer (progress report). In four previous papers the production and properties of gastro-toxic serum, obtained by immunising the rabbit with guinea-pig's gastric cells, were described, and it was demonstrated that the ulcers produced by the serum healed within three or four weeks if the animal were in its normal condition and fed on a normal diet. Since chronic gastric ulcer in the human subject is a common malady, and gastric ulceration is initially acute, it was considered that some unknown condition or conditions must be present which delay the healing of these ulcers. It was, however, found on experiment that so long as the stomach emptied itself in the normal time it was impossible to delay the healing of gastric ulcer by increased or diminished acidity of the gastric contents or by feeding on infected food; the position of the ulcer in the stomach did not materially affect the result. The present communication deals with the effects of interference with the motor function of the stomach upon the healing of ulcer, the food and acidity of the stomach contents being normal. The gastric ulcers were produced in the cat by the local injection of gastro-toxic serum into the stomach wall, the serum being prepared by immunising the goat with the gastric cells of the cat. Motor insufficiency of the stomach, leading to retention of its contents, which is one of the commonest forms of indigestion of food in man, was produced by constricting the pylorus of the cat by means of rubber tubing, the ulcer then being formed on the anterior wall of the stomach. It was found that in these circumstances the healing of the ulcers was delayed for at least twice the normal time. The ulcers, however, eventually healed up, but the regenerated mucous membrane was of a lower type than normal. Thus it may consist on the forty-first day of a single layer of cubical cells such as should be found on the tenth day of normal healing, or of glands formed entirely of duct epithelium. It was further found that the more sclerotic the base of the scar the more badly developed was the mucous membrane. In certain cases the *normal* healing of the ulcers was occasionally delayed by necrosis of the granulation tissue forming their bases, or by excessive formation of fibrous tissue, and in these cases the mucous membrane was of the lower type. It was therefore considered that the delay in healing in motor insufficiency was an exaggeration of the condition occasionally seen in the normal state. Both conditions are due to digestion or irritation of the base of the ulcer, leading to necrosis or increased formation of fibrous tissue, so that the regenerated mucous membrane is either unable to grow over it at all or only consists of a single layer of cells or of glands of a lower type than normal. When the base is excessively fibrous the glands have not a sufficiently vascular and cellular stroma in which to proliferate.—Dr. G. **Dreyer** and J. Sholto C. **Douglas**: The velocity of reaction in the "absorption" of specific agglutinins by bacteria, and in the "adsorption" of agglutinins, trypsin, and sulphuric acid by animal charcoal. Though a fair number of observations exist as to the influence of time on the so-called adsorption processes, *e.g.* the adsorption of a dye by a fibre (Bordet, Bayliss, &c.) proving that it takes a very considerable time before equilibrium is reached, the study of the time reaction in the taking up of agglutinins by bacteria has been confined to the observations of Eisenberg and Volk. These authors maintain that the velocity of reaction is extremely fast, and that equilibrium is reached in five minutes, even at a temperature of 0° C., and that no appreciable difference is to be found in the absorption velocity, whether the reaction takes place at 0° C. or 37° C. The present authors' results, which are contradictory to those of Eisenberg and Volk, may be summarised as follows:—(1) the establishment of equilibrium in the absorption of agglutinins by their specific bacteria is not attained, as stated by Eisenberg and Volk, in less than five minutes at 0° C., but takes a considerable time, since equilibrium is not reached at room temperature even in four hours; (2) the adsorption of agglutinin or trypsin by charcoal does not reach an equilibrium within four hours at room temperature, nor the adsorption of sulphuric acid by charcoal in twenty-four hours, or possibly even in forty-eight hours; (3) there is no justification for judging as to the nature of the interaction between an absorbing substance and a material absorbed from the rapidity or slowness with which equilibrium is attained, as has been done by Arrhenius.—Dr. G. **Dreyer** and J. Sholto C. **Douglas**: The absorption of agglutinin by bacteria, and the application of physico-chemical laws thereto. Eisenberg and Volk, in 1902, were the first to make more or less exact quantitative measurements of the absorption of agglutinins by bacteria. They showed that if agglutinating serum were treated in varying dilutions with a constant amount of homologous bacteria, the amount of agglutinin taken away was not constant, but that in a concentrated serum the absolute amount removed was greater than in a diluted serum, whilst, on the other hand, the relative amount taken away in a dilute serum was much the greater. By taking the experiments of Eisenberg and Volk, Arrhenius showed the existence of a relation between the quantity of absorbed agglutinin, C, and of the agglutinin left in the fluid, B, and expressed this relationship in the simple formula $C = kB^n$. The result of the present experiments may be summarised as follows:—(1) when an agglutinating serum in different concentrations is treated with constant amounts of bacteria, the quantity absorbed, C, may not only increase to a limit value, but may, when this point is passed, even decrease to zero when the concentration of the serum is further increased, which is quite different to the statement of Eisenberg and Volk; (2) it is impossible, from the greater or smaller size of the exponent "*n*" in the formula $C = kB^n$, to determine whether, in the case of agglutinin, we have to deal with an absorption or an adsorption process, as done by Arrhenius, as in both cases "*n*" may vary within nearly the same ranges; (3) the formula $C = kB^n$, proposed by Arrhenius to express the absorption of agglutinin by bacteria, as being a special example of the Guldberg and Waage law of chemical mass action, does not hold good either in the case of the absorption of agglutinin by bacteria or of the neutralisation of agglutinin by homologous bacterial filtrate; (4) the combination of agglutinin and bacteria is therefore not such a simple process as anticipated by Arrhenius, but is very possibly complex, and not improbably of the same nature as the interaction of bacterial toxins and anti-toxins.—V. H. **Veley** and A. D. **Waller**: Observations on the rate of action of drugs upon muscle as a function of temperature. The authors tested the problem by observations on the rate of action on muscle of alcohol, chloroform, quinine, and aconitine, at temperatures between 7° and 25°. They used Esson's formula, modified for their purpose, for the calculation of results,

$$\log L_0 - \log L_1 = m(\log T_1 - \log T_0)$$

(where L_0 and L_1 are the lengths of time between application of the drug and cessation of contraction, and T_0 and T_1 the absolute temperatures at which the action took place; m is the experimental constant). The values of m came out as follows:—alcohol = 20·5; chloroform = 14·3; quinine = 26·7. (The values of m in the case of hydrogen peroxide and hydrogen iodide = 20·38, and in that of chloric acid and ferrous sulphate = 26·5.) The corresponding temperature-coefficients per 10° are:—alcohol = 2·02; chloroform = 1·63; quinine = 2·52. (In a previous rough determination the authors found ether = 2.) The data from which the value of m was calculated in the case of chloroform are as follows:—

Temp.	Lengths of time.	$\log T_1/T_0$	$\log L_0/L_1$	m
7°	24·5′	0000	0000	
10°	21′	0017	0670	14·3
19°	13′	0182	2753	15·1
24°	10·5′	0257	3673	14·3
24°	11′	0257	3478	13·5

Mean = 14·3

The action of aconitine is completely arrested at 7°, and manifests itself as soon as the temperature is raised to 17°.—V. H. **Veley**: An examination of the physical and physiological properties of tetrachlorethane and trichlorethylene. Symmetrical tetrachlorethane, $CHCl_2CHCl_2$, was originally prepared about forty years ago from acetylene and chlorine gas in presence of antimony chloride. It is now prepared on a large scale by the same reaction, aluminium chloride being used instead of the antimony salt. Trichlorethylene, $CHClCCl_2$, is obtained from tetrachlorethane by heating with alkalies. Certain determinations of the densities and refractive index μ_a of tetrachlorethane have been published, but those of trichlorethylene have been curiously overlooked. Values are given of densities at certain temperatures and refractive index μ_D at 17° in the paper. The effects of both substances on isolated muscle are compared with that of chloroform. It is shown that toxicities of chloroform, trichlorethylene, and tetrachlorethane are in the ratio 1/1·5/4. It is further noted that the action of trichlorethylene is more regular than that of any other drug or anæsthetic examined by this method. Preliminary experiments with living animals have shown that anæsthesia produced by this compound is also of a very regular type.—J. D. **Thomson** and Prof. A. R. **Cushny**: The action of antimony compounds in trypanosomiasis in rats.—Sir David **Bruce**, Captains A. E. **Hamerton** and H. R. **Bateman**, and Captain F. P. **Mackie**: "Amakebe" (a disease of calves in Uganda).—Sir W. **Crookes**: Scandium. This is a continuation of the paper read in April, 1908 (Phil. Trans., A, vol. ccix., pp. 15–46), in which, after describing the mode of extracting scandia from the mineral wiikite, the principal salts, twenty-three in number, were described, their formulæ and analytical results being given in detail.

In the present paper the following salts are described, their preparation, analyses, and formulæ being given:—

Scandium Aurochloride, $3ScCl_3,2AuCl_3,21H_2O$.

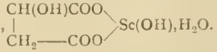
Scandium aurochloride is prepared by mixing strong solutions of the component chlorides, and allowing the mixture to evaporate slowly over sulphuric acid in a vacuum desiccator. The double salts separate out in a felt-like mass of needle-shaped crystals of a yellow colour and very deliquescent. The water of crystallisation gradually goes off when the salt is kept in a desiccator over sulphuric acid, definite hydrates being formed. In this manner the following hydrates have been formed:—

8-Hydrate Scandium Aurochloride, $3ScCl_3,2AuCl_3,8H_2O$, and the

2-Hydrate Scandium Aurochloride, $3ScCl_3,2AuCl_3,2H_2O$.

By long-continued drying at 100° all the water is driven off, and the aurochloride melts to a clear orange-coloured liquid, solidifying to a crystalline mass on cooling. After keeping the salt for several days at 100° the liquid gradually becomes solid and crystalline, and in this state it is anhydrous, and has the composition $3ScCl_3,2AuCl_3$. Scandium platinocyanide, $Sc_2[Pt(CN)_4]_3 + 21H_2O$, is formed by the metathesis in the cold of scandium sulphate and barium platinocyanide. It crystallises out in large monoclinic prisms on a rhombic base, the angles of which are 81° 20′ and 98° 40′. They are very soluble in water, and are insoluble, or nearly so, in absolute alcohol, and frequently group themselves in rosettes. They are dichroic, crimson by transmitted light, and a rich metallic green by reflected light. The reflected and transmitted rays are oppositely polarised. Scandium iodate, $Sc(IO_3)_3 + 18H_2O$, is prepared by the metathesis of a soluble scandium salt with ammonium iodate. It forms a white crystalline powder almost insoluble in water. Scandium sulphite, Sc_23SO_3, is a white insoluble powder formed by mixing a soluble scandium salt with sodium sulphide. It is anhydrous, and gradually decomposes on exposure to dry air.

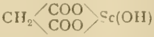
Scandium Malate,



$$\left.\begin{array}{l}CH(OH)COO\\ |\\ CH_2\text{——}COO\end{array}\right\rangle Sc(OH),H_2O.$$

Malic acid and scandium hydroxide react when rubbed together with a little water, and the liquid becomes clear on being heated. When gradually cooled a precipitate appears, and at the ordinary temperature of the laboratory the solution is opaque and almost solid. Scandium malate is a granular white powder, soluble in hot and difficultly soluble in cold water. It is easily soluble in ammonia, and is not precipitated from the ammoniacal solution by dilute acetic or malic acid.

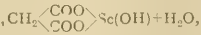
Scandium Malonate,



$$CH_2\left\langle\begin{array}{l}COO\\ COO\end{array}\right\rangle Sc(OH)$$

Scandium hydroxide dissolves readily in a cold aqueous solution of malonic acid, and on being heated the solution deposits a semi-transparent granular precipitate, having no crystalline appearance under the microscope. This precipitate partially dissolves on cooling. If this solution is boiled for some time a dense precipitate is formed, which does not re-dissolve on cooling. According to the mode of preparation scandium malonate contains either one or two molecules of water:—

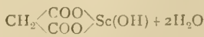
Mono-hydrated Scandium Malonate,



$$CH_2\left\langle\begin{array}{l}COO\\ COO\end{array}\right\rangle Sc(OH) + H_2O,$$

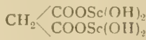
and

Di-hydrated Scandium Malonate,



$$CH_2\left\langle\begin{array}{l}COO\\ COO\end{array}\right\rangle Sc(OH) + 2H_2O.$$

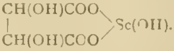
Basic Scandium Malonate,



$$CH_2\left\langle\begin{array}{l}COOSc(OH)_2\\ COOSc(OH)_2\end{array}\right.$$

When a large excess of scandium hydroxide is gently warmed with an insufficient amount of malonic acid to dissolve it, and the filtered solution is well boiled, a basic salt is precipitated having the above composition.

Scandium Tartrate,

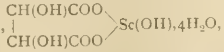


$$\left.\begin{array}{l}CH(OH)COO\\ |\\ CH(OH)COO\end{array}\right\rangle Sc(OH).$$

Scandium hydroxide is added to a strong solution of tartaric acid with slight warming until the greater part of the scandium hydroxide is dissolved, care being taken to keep the base in slight excess. The turbid solution is filtered and boiled. A granular precipitate comes down.

This is well washed with boiling water and dried in a desiccator over sulphuric acid. Formed in this way, scandium tartrate forms a white crystalline powder, insoluble in hot and slightly soluble in cold water, and insoluble in alcohol.

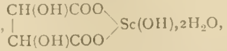
Scandium Racemate,



$$\begin{matrix}\mathrm{CH(OH)COO} \\ | \\ \mathrm{CH(OH)COO}\end{matrix}\!\!>\mathrm{Sc(OH)},4\mathrm{H_2O},$$

is prepared in a similar manner to the tartrate. The two salts are, however, not quite similar, as the racemate comes down less plentifully on boiling, and it is not anhydrous as is the tartrate, but contains four molecules of water, one of which is driven off at 115°.

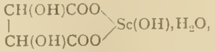
Scandium Lævo-tartrate,



$$\begin{matrix}\mathrm{CH(OH)COO} \\ | \\ \mathrm{CH(OH)COO}\end{matrix}\!\!>\mathrm{Sc(OH)},2\mathrm{H_2O},$$

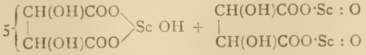
is prepared in a similar way to the tartrate. When dried in a desiccator over sulphuric acid it contains one molecule of water. Dried in the air it contains two molecules of water.

Scandium Meso-tartrate,



$$\begin{matrix}\mathrm{CH(OH)COO} \\ | \\ \mathrm{CH(OH)COO}\end{matrix}\!\!>\mathrm{Sc(OH)},\mathrm{H_2O},$$

is prepared by gently warming a slight excess of scandium hydroxide with aqueous meso-tartaric acid, and then boiling the filtered solution. The meso-tartrate comes down as a white granular precipitate. The analysis of the compounds of scandium with tartaric acid and its isomers has been complicated by the tendency to form basic salts admitting of no simple formulæ. Thus both the tartrate and lævo-tartrates occasionally form salts containing percentages of scandium ranging near to 23·5, with a deviation of two- or three-tenths of a unit one side or the other. The nearest basic salt which contains such an amount of scandium has the composition



$$5\left\{\begin{matrix}\mathrm{CH(OH)COO} \\ | \\ \mathrm{CH(OH)COO}\end{matrix}\right.\!\!>\mathrm{Sc\ OH} + \begin{matrix}\mathrm{CH(OH)COO{\cdot}Sc : O} \\ | \\ \mathrm{CH(OH)COO{\cdot}Sc : O}\end{matrix}$$

and contains 23·49 per cent. of scandium.

Linnean Society, December 16, 1909.—Prof. E. B. Poulton, F.R.S., vice-president, in the chair.—Rev. T. R. R. **Stebbing**: (1) Report on the Crustacea Isopoda and Tanaidacea collected by Mr. Crossland in the Sudanese Red Sea; (2) Isopoda from the Indian Ocean and British East Africa. Among the Red Sea species the most interesting novelty is one named *Lanocira latifrons*, in allusion to the peculiar widening of the frontal process. In British East Africa, Wasin has yielded a new genus and species meriting the significant appellation *Kalliapseudes makrothrix*, which may be rendered in the vulgar tongue as the "long-haired beauty of the Apseudidæ." The species is remarkable for the extensive fringes of feathered setæ on the mandibles, maxillipeds, and first gnathopods, as well as for the short round-ended finger of its second gnathopods. In the Stanley Gardiner collection the new species *Apanthura xenocheir* is unique within its own family in the structure of the hand and finger of the first gnathopods. The new genus and species *Pontógelos aselgókeros*, of the family Eurydicidæ, from Mauritius, displays a prolongation of the first antennæ hitherto unexampled in that family. Several new species and a new genus of Epicaridea, isopods parasitic on other crustaceans, are described from specimens transmitted by Miss M. J. Rathbun, who had extracted them with great care from the crabs of the Stanley Gardiner Expedition. In one instance it proved that the maternal pouch of the parasite was occupied, not by the usual enormous mass of eggs, but by another parasite, probably itself an epicaridean, though strangely metamorphosed. The discussion of this difficult tribe was opportune for offering a tribute of respect to the memory of the late Prof. Alfred Giard, one of whose latest writings was a luminous essay on Lamarck and Darwin.—Prof. G. H. **Carpenter**: Pycnogonida from the Red Sea and Indian Ocean, collected by Mr. Cyril Crossland.—R. **Shelford**: A collection of Blattidæ preserved in amber, from Prussia.—A. W. **Waters**: The Bryozoa from collections made by Mr. C. Crossland, part ii., Cyclostomata, Ctenostomata, and Endoprocta. The collections dealt with only contain sixteen species, and these are nearly all known from the Mediterranean, while nine are British. In this and the previous paper ninety-nine Red Sea species and varieties are referred to; of these, 34 are known from the Atlantic, 26 from British seas, 39 from the Mediterranean, 34 from Indian and neighbouring seas, 17 from Crossland's Zanzibar collection, 8 from Japan, 35 from Australia. The classification of the Ctenostomata is examined, and it is considered that the group Stolonifera of Ehlers must be divided into Vesicularina and Stolonifera. In the first there is usually a moderately thick erect stem from which the zoœcia arise directly, and they all have gizzards, an organ not general in the Ctenostomata, and probably confined to this group. In the Stolonifera as now reduced there is a delicate creeping rhizome expanding at intervals, and from these places the zoœcia arise, usually in pairs. There is no gizzard. The gizzards of the Vesicularina usually have a large number of sharp and irregular teeth surrounded by a band of strong muscles, but in Cryptopolyzoon the gizzard has but two teeth with nearly flat edges.

Geological Society, January 12.—Prof. W. J. Sollas, F.R.S., president, in the chair.—C. I. **Gardiner** and Prof. S. H. **Reynolds**; with a palæontological appendix by F. R. C. **Reed**: The igneous and associated sedimentary rocks of the Glensaul district (County Galway). The general succession of the rocks of the Glensaul district is given, in descending order, in tabular form. The graptolitic beds occurring in the Mount Partry beds have yielded nineteen species, which indicate the upper part of the zone of *Didymograptus extensus*. The commonest species met with are *D. extensus*, Hall, and *D. bifidus*, Hall. In a previous description of the rocks of the Tourmakeady district, the term Shangort beds was applied to a series of grits and tuffs, and the term Tourmakeady beds to an associated series of calcareous strata which generally take the form of limestone-breccias. In the Glensaul district it is not possible to draw a sharp line of distinction between the two rock-types. The fossils from the Shangort and Tourmakeady beds show a close resemblance to those of the Tourmakeady district, but the finding of certain additional forms, especially *Nileus armadillo* and Niobe sp., has impressed the close connection between this fauna and that of the Orthoceras Limestone of Sweden, and it is rather of Arenig than of Llandeilo age. The conclusion is in conformity with the field evidence. The relegation of the Shangort and Tourmakeady beds of Glensaul to the Arenig would imply a similar age for those of the Tourmakeady district. The Glensaul district contrasts strongly with that of Tourmakeady as regards the character of the crystalline igneous rocks, which are all quartz-felsites. One species of Illænus, one of Niobe, one of Nileus, two of Bathyurus, three of Cheirurus, one of Pliomera, one of Encrinurus, one of Phacops, and a new species of Bathyurellus are described; also three species of Orthis, one of Hyolithes, one of Rafinesquina, one of Camerella, and one of Porambonites.—Prof. E. W. **Skeats**: The gneisses and altered dacites of the Dandenong district (Victoria), and their relations to the dacites and to the granodiorites of the area. The area described lies about twenty-five miles south-south-east of Melbourne. The early geological surveyors regarded the dacites as Palæozoic "traps" passing into the granodiorites. Prof. J. W. Gregory described the rocks as dacites, probably of Lower Tertiary age, resting upon the denuded surface of the granodiorites and of the adjoining Lower Palæozoic sediments. The field-relations of the rocks are described, and gneiss is shown to occur between the dacite and the granodiorite. The contact with the plutonic rock is abrupt. No foliation or banding occurs in the granodiorites, but acid veins pass from the junction into the altered dacite and also cut across the foliations of the gneiss. The field-evidence shows that the dacites are older than the granodiorites, and also that the gneiss was formed before the intrusion of the acid veins. The chemical evidence indicates that differentiation of a magma took place; the dacite was first erupted, and, following on that, the granodiorite (of more acid composition) was intruded into the dacite. In the altered dacites a schistosity occurs near the contact, ilmenite is changed to biotite by reaction with the felspar in the ground-mass, biotite is corroded by the ground-mass, and hypersthene is altered at its margin to biotite and quartz. Finally, granules of blue tourmaline occur in the contact-rocks. In the gneiss, hypersthene is not found, ilmenite is rare, and the rock is foliated. The gneiss is probably a modification of the dacite, but evidence as to its origin is incomplete. It may be the result of extreme contact-metamorphism of a dacite of peculiar character, such as a tuff. Possibly it was produced by differential movement in the dacite before complete consolidation, and certainly before the intrusion of the granodiorite.—H. J. **Grayson**: Recent improvements in rock-section cutting apparatus. The apparatus comprises a slitting disc of mild steel and two bronze grinding laps mounted on a substantial wooden table. The discs and laps are each 10 inches in diameter, and revolve at about 900 revolutions a minute. The discs and laps are connected with endless belts, which in turn are connected with wheels driven by a 1-horse-power electric motor. Special clamps are used to attach the rock-specimen and to cut the slice. A goniometric crystal-holder, permitting of slicing in any desired direction, is described, and can be fitted to one of the clamps. Clamps swinging radially across the grinding laps permit the parallel grinding of the slice to any thinness. A polishing lap can be placed in the position of one of the grinding laps. The finishing of the slice is done by hand on a slate disc.

Zoological Society, January 18.—Prof. J. Rose Bradford, F.R.S., vice-president, in the chair.—S. A. **Neave**: Collections of butterflies made during four years spent in northern Rhodesia and adjacent territories. The collection comprised 450 species, of which thirty were new to science, besides several rare and little-known species, including the rare *Acraea mirifica*, Lathy, and the hitherto unknown female.—J. T. **Cunningham**: Marine fishes and invertebrates of St. Helena. The scientific results of a visit to the island in February and March, 1909, for the purpose of investigating the condition and prospects of the fisheries of the island. The author's report on the results of the investigation from the economic point of view has been presented to the Colonial Office. The invertebrates collected have been examined and identified by specialists of the Natural History Museum, namely, Dr. Calman, Mr. Edgar Smith, Prof. Jeffrey Bell, and Mr. Kirkpatrick, the last-named having described a new species of sponge and a new hydroid. The fishes have been worked out by the author himself, and include two new species, one belonging to the Stromateidæ and one to the Cyphosidæ. The three kinds of Albacore occurring at St. Helena are shown to be identical with the three species diagnosed at Madeira by the Rev. R. T. Lowe in 1839, namely, *Thynnus alalonga*, *T. albacora*, and *T. obesus*, species which have been confused or rejected by recent ichthyologists; the synonymy and distribution of these are for the first time correctly elucidated.—Dr. W. T. **Calman**: Second and concluding part of a report on new or rare Crustacea of the order Cumacea, from the collection of the Copenhagen Museum. This portion of the report deals with the families Nannastacidæ and Diastylidæ, and twenty-seven species are described, all of which are regarded as new, and three new genera are established.—Prof. W. M. **Smallwood**: Hydroids and nudibranchs of Bermuda.

Institute of Metals, January 19.—Sir Gerard A. Muntz, Bart., president, in the chair.—O. F. **Hudson** and E. F. **Law**: A contribution to the study of phosphor-bronze. This paper was intended to amplify the conclusions arrived at by A. Philip, who presented a contribution on phosphor-bronze to the Institute of Metals at the Birmingham meeting of the institute in 1908. The authors endeavoured to indicate the relation between the mechanical and other properties of the copper-tin-phosphorus alloys and their constitution and structure. A useful diagram was included in the paper showing the constitution of all the alloys containing up to 25 per cent. of tin. The paper included notes on the examination and analysis of the phosphor-bronzes, and was illustrated by a remarkably clear and numerous collection of photomicrographs illustrating the structure of the alloys. Many of these photographs were originally of 1000 diameters, and these were further enlarged by being projected on a screen from lantern-slides made from autochrome plates, the marvellous blue-green and red colourings of the various constituents thereby being brought before the notice of the audience in a very novel and effective manner.—T. Vaughan **Hughes**: The failure in practice of non-ferrous metals and alloys, with particular reference to brass loco-tubes. This was essentially a practical, as distinct from an academic, paper, and dealt especially with an investigation into the cause of a breakdown of brass loco-tubes which had led to serious casualties and a Government inquiry. The failure was found to be due to the formation of a "scale," only 0·05 mm. thick, which offered a resistance of 20 megohms to an E.M.F. of 250 volts when dry and 150,000 ohms when wet. This electrical measurement showed the heat conductivity of the scale, and explained the over-heating of the tube at the point where the breakdown had occurred.—C. O. **Bannister**: The use of carbonaceous filters in the smelting of zinc. The paper was a corollary of that entitled "Notes on the Production of Pure Spelter," by J. S. G. Primrose, read at the Manchester meeting of the institute in October, 1909. Mr. Bannister described particularly the filters used in the Hopkins fumeless zinc process. The process was stated to have begun with the object of producing lead-free zinc only, but it now embraced three objects—the manufacture of pure spelter, the prevention or reduction of zinc fume, and the obtaining of higher yields.

Royal Meteorological Society, January 19.—H. **Mellish**: Presidential address, on some relations of meteorology with agriculture. The close dependence of agriculture upon climate and upon the periodical variations of the weather has been recognised from the earliest times, but the relations are of such a complicated character, and the difficulty of separating the effects of the different factors is so considerable, that as much progress as might have been expected has perhaps not been made in applying the data of meteorology to the purposes of agriculture. The president first referred to the writings of various authors on the subject of temperature and rainfall, as affecting the wheat and other crops, and then proceeded to deal with such questions as the liability of some crops, and especially of fruit, to injury from frosts; the influence exercised by forests upon climate, and especially upon rainfall; and the study of phenology. He next considered what steps meteorologists could take to further the application of the data of their science to the various problems of agriculture. It is doubtful whether farmers make as much use of the forecasts and weather reports as they might. Possibly this may arise because they are not familiar with the technical terms in which the reports are necessarily couched. This might be remedied in the course of time if instruction on the subject could be worked into the courses at the agricultural schools and colleges. The Royal Meteorological Society has lost no opportunity of urging the importance of the subject to farmers, and also the inclusion of meteorology under the head of nature-study in the schools, and there are reasons to think that this is having some effect.

MANCHESTER.

Literary and Philosophical Society, December 14, 1909.—Mr. Francis Jones, president, in the chair.—Dr. S. **Russ**: A note on radio-active recoil. When radium emanation is condensed at the bottom of a glass tube from which the air has been removed, active deposit particles are radiated up the tube. This phenomenon has been attributed to the recoil of the atom when an α particle is ejected from it. A disc suspended above the emanation may be the recipient of the active deposit particles. An analysis has been made of the decay curves exhibited by such a disc when exposed for different times. The conclusions arrived at are that the numbers of Radium A and radium B particles projected from the emanation are about equal, and that in comparison with them the quantity of radium C projected is insignificant. This latter result has recently been shown experimentally by Dr. Makower and the author.—D. M. S. **Watson**: A preliminary account of the bibliography of the post-Triassic Sauropterygia.

January 11.—Mr. Francis Jones, president, in the chair.—Prof. F. E. **Weiss**: Variability in the flowers of Tropæolum hybrids. A year ago a Tropæolum was observed by Prof. Weiss which showed at the same period three types of flowers, some yellow, some yellow with red markings, and some completely claret coloured. There seemed no marked periodicity in the occurrence of these flowers in 1908, though sometimes the yellow and sometimes the parti-coloured flowers predominated; but in an offspring of this plant it was noticeable that the parti-coloured and red flowers occurred only during the fine, hot weather in the second week in August, while during the cold and wet periods of July, September, and October all the flowers were yellow. This indicated a determining influence of temperature and light, and it is borne out by experiments in self-fertilising the variously coloured flowers. In the second (*f2*) generation a variety of different plants arose by segregation, and the colour of the parental flower had no determining effect, yellow flowers yielding red offspring and *vice versa*. Incidentally, the segregation of characters in the second (*f2*) generation showed that in Tropæola, dwarfness is recessive to tallness, as is the case in sweet-peas, and that red sap is a dominant character, though sometimes not apparent owing to unpropitious external conditions. This potential redness is, of course, different from the latent condition of a recessive character, which cannot be called into evidence by external conditions.

DUBLIN.

Royal Irish Academy, January 10.—Dr. F. A. Tarleton, president, in the chair.—Sir Robert S. **Ball**: Contributions to the theory of screws, viz.:—(1) on the expression for the virtual coefficient of two vector-screws; (2) on the composition of twists or wrenches on vector-screws; (3) on the pitch operator,

$$\Delta = \frac{d}{dp_1} + \frac{d}{dp_2} + \ . \ . \ . \ + \frac{d}{dp_n}.$$

(4) applications of quaternions to the theory of screws; (5) use of quaternions in the theory of reflected screws; (6) quaternion investigation of the screw reciprocal to five given screws; (7) representation of screw systems of the third order by linear vector functions. The virtual coefficient of two screws α and β is

$$\tfrac{1}{2}\{(p_\alpha + p_\beta)\cos\theta - d\sin\theta\},$$

where p_α p_β are the pitches of the two screws, and d is the length of their common perpendicular. It is here explained how θ can be measured without any ambiguity when α and β are regarded as *vector-screws*. The pitch operator Δ can be applied to any general formula connecting n screws belonging to an $(n-1)$ system, and by successive application a group of new formulæ can sometimes be derived. The application of quaternions to the theory of screws is founded on Hamilton's theorem as developed by Joly, that if μ be a vector moment and λ a vector force, then $S\mu/\lambda$ is the pitch of the screw on which the wrench lies, and $V\mu/\lambda$ is the vector perpendicular from the origin on the screw. One of the most fundamental theorems in the theory of screws asserts the existence of one screw and, in general, only one screw reciprocal to five given screws. The expression is here given of the vector coordinates of the screw reciprocal to the five screws

$$(\mu_1, \lambda_1);\ (\mu_2, \lambda_2);\ (\mu_3, \lambda_3);\ (\mu_4, \lambda_4);\ (\mu_5, \lambda_5).$$

This is, as might be expected, a symmetrical form with regard to the five screws, and leads, among many other results, to a concise expression for the sexiant which when equated to zero gives the condition that six screws shall belong to a five-system. Joly showed that Hamilton's beautiful theory of linear vector functions receives its geometrical representation by the system of screws of the third order. The fundamental properties of linear vector functions can be explained as immediate consequences of the theory of screws.

PARIS.

Academy of Sciences, January 17.—M. Emile Picard in the chair.—E. **Bouty**: The electric cohesion of neon. Although the molecular weight of neon is intermediate between argon, the molecular weights, and helium, its dielectric cohesion is much lower than that of the latter. The dielectric cohesion of neon is lower than that of any known gas; from the point of view of the obstacle opposed to the electric discharge, 57 cm. of neon are equivalent to a layer of 1 cm. of air.—W. **Kilian**: A new example of phenomena of convergence in ammonites: the origins of the group *Ammonites bicurvatus*.—A. **de Gramont**: The distribution of the ultimate lines in stellar spectra.—A. **Demoulin**: The K systems and congruences.—M. **Cisotti**: An application of the method of Jacobi.—Ludovic **Zoretti**: Ensembles of points.—L. **Décombe**: The elimination of directing electric couples, and effects due to asymmetry, to the absence of regulation and to contact electromotive forces in quadrant electrometers.—Edmond **Bauer** and Marcel **Moulin**: The constant in Stefan's law and the radiation of platinum. In a recent paper the authors described a method of determining the constant σ in Stefan's equation $E=\sigma T^4$ by the comparison of the radiation of a black body at 1064° C. with the radiation of a platinum sheet, known, in absolute measure, by experiments in a vacuum. It was assumed that the radiation of platinum followed Lambert's law up to large angles of emission; the latter assumption has now been proved by experiment to be inaccurate, and the introduction of the resulting correction reduces the original value of σ from $6{\cdot}0\times10^{-12}$ to $5{\cdot}3\times10^{-12}$, a figure in good agreement with the $5{\cdot}32\times10^{-12}$ of Kurlbaum.—A. **Colson**: The difficulties of chemical bibliography. A reply to some criticisms of M. Baubigny.—E. **Kohn-Abrest**: The action of heat upon aluminium in a vacuum. Aluminium is volatilised appreciably at 1100° C. in a vacuum, setting free silicon from the walls of the tube if the latter contains a silicate.—G. **Charpy** and S. **Bonnerot**: The cementation of iron by solid carbon. In these experiments both the iron and the carbon were submitted separately to a prolonged heating in a vacuum until no trace of gas was given off. The iron and carbon were then heated in contact at 1000° C., in a high vacuum, for several hours. No trace of carbon was absorbed by the metal under these conditions, although cementation was produced if traces of air were present.—Pierre **Camboulines**: The action of the vapours of carbon tetrachloride on anhydrides and oxides. The action of carbon tetrachloride vapour upon thirty-three oxides was studied. Silica and boric anhydride were not attacked; in the other cases a reaction took place at temperatures between 215° C. (niobic anhydride) and 580° C. (chromium oxide), the pure chloride of the metal being formed, excepting with niobic anhydride, thorium, and uranium oxides. With these a mixture of chloride and oxychloride was formed. This reaction furnishes a good general method for the preparation of anhydrous metallic chlorides.—R. **Fosse**: The transformation of some aromatic alcohols into phosphinic acids by hypophosphorous acid.—Gabriel **Bertrand** and G. **Weisweiller**: Vicianose, a new reducing C_{11} sugar. By the action of a diastatic preparation extracted from *Vicia angustifolia* upon the cyanhydric glucoside vicianine described in a previous paper, a new reducing sugar has been isolated. It has the composition $C_{11}H_{20}O_{10}$, and is the first definite biose prepared by the diastatic hydrolysis of a glucoside.—Marcel **Guerbet**: The condensation of secondary butyl alcohol with its sodium derivative; 3-methyl-5-heptanol and an alcohol, $C_{12}H_{26}O$, result from this condensation.—A. **Verneuil**: The synthetic reproduction of the sapphire by the method of fusion. Blue sapphires, possessing the colour and optical properties of the natural stone, have been prepared by heating alumina containing 1·5 per cent. of magnetic oxide of iron and 0·5 per cent. of titanic acid in the oxyhydrogen blowpipe.—A. **Conte**: Anomalies and spontaneous variations in the domestic birds.—Louis **Masson**: The tolerance of bacteria to antiseptics. Three species, *B. pyocyaneus*, *B. subtilis*, and *B. anthracis*, were grown in cultures containing small amounts of antiseptics (resorcinol, salicylic acid, copper sulphate, and mercuric chloride), and the proportion of the antiseptic was increased in successive cultures. The bacteria adapted themselves to increasing amounts of the poison, and attained a maximum resisting power, followed by a rapid fall, losing the whole of the acquired resistance. The tolerance was thus shown to be a temporary phenomenon, an example of the resistance of the species to variation.

CALCUTTA

Asiatic Society of Bengal, January 5.—Hem Chandra **Das-Gupta**: A probable identity between *Clypeaster complanatus*, Duncan and Sladen, and *C. duncanensis*, Noetling. The author gives reasons for thinking that *C. duncanensis*, Noetl., was founded on large specimens of *C. complanatus*, Duncan and Sladen.—I. H. **Burkill**: Fashion in iron styles. A paper to show that the iron styles used in India for writing on palm leaves are of different types in different parts of the country. The iron styles of the extreme south-west are heavy; those of the centre of the Coromandel coast are peculiarly long and generally light; those of Orissa are quite characteristic; the type which is like a clasp-knife is confined to the south. The paper is a supplement to the account of Indian pens published recently in the Agricultural Ledger, No. 6, of 1908–9.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 27.

ROYAL SOCIETY, at 4.30.—Long Period Determination of the Rate of Production of Helium from Radium: Sir James Dewar, F.R.S.—Note on Carbon Mono-sulphide: Sir James Dewar, F.R.S., and Dr. H. O. Jones.—On the Extinction of Colour by Reduction of Luminosity: Sir William de W. Abney, K.C.B., F.R.S.—The Initial Accelerated Motion of Electrified Systems of Finite Extent, and the Reaction produced by the Resulting Radiation: G. W. Walker.—On the Nature of the Magnetokathodic Rays: H. Thirkill.—On the Velocity of Steady Fall of Spherical Particles through a Fluid Medium: E. Cunningham.—The Photo-chemical Formation of Formaldehyde in Green Plants.:—Dr. S. B. Schryver.

ROYAL INSTITUTION, at 3.—Assyriology: Rev. C. H. W. Johns.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Equitable Charges for Tramway Supply: H. E. Yerbury.

FRIDAY, JANUARY 28.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Some Uses of Mechanical Power in Engineering Construction: H. F. Donaldson.

SATURDAY, JANUARY 29.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.—Trawl Fishing in the North Sea: S. H. Goodchild.

MONDAY, JANUARY 31.

ROYAL SOCIETY OF ARTS, at 8.—Textile Ornamentation: Alan S. Cole, C.B.

INSTITUTE OF ACTUARIES, at 5.—Some Points of Interest in the Operations of Friendly Societies, Railway Benefit Societies, and Collecting Societies: A. W. Watson.

TUESDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 3.—The Cultivation of the Sea: Prof. W. A. Herdman, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—Imperial Colonial Development: C. Reginald Enock.

ZOOLOGICAL SOCIETY, at 8.30.—On a Collection of Freshwater Crustacea from the Transvaal: Hon. Paul A. Methuen.—(1) Littoral Marine Fauna: Kerimba Archipelago, Portuguese East Africa, collected by J. J. Simpson. Sept., 1907, to May, 1908. Holothurioidea; (2) Marine Fauna: Mergui Archipelago, Lower Burma, collected by J. J. Simpson and R. N. Rudmose-Brown. Holothurioidea: Dr. Joseph Pearson.—A Revision of the British Species of Ostracoda belonging to the Subfamilies Candoninæ and Herpetocyphridinæ: Dr. G. Stewardson Brady.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: The Reconstruction of the Tyne North Pier: I. C. Barling.—*Probable Papers*: Notes on the Sheffield Water-supply and Statistics relating thereto: L. S. M. Marsh.—Statistical and Experimental Data on Filtration: W. R. Baldwin-Wiseman.

WEDNESDAY, FEBRUARY 2.

ROYAL SOCIETY OF ARTS, at 8.—An Improved Method of Electro-plating: A. Rosenberg.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Annual Meeting, Presidents' Address.—The Composition and Analysis of Tea: R. R. Tatlock and R. T. Thomson.—The Examination of Turpentine Substitutes, and the Determination in Turpentine of Hydro-carbons other than Terpenes: J. H. Coste.—The Determination of the Acid Radical, and its Relation to the Constitution of Commercial Bismuth Subnitrate: J. Bristowe P. Harrison.—On Sheep Dips: J. S. Remington.

ENTOMOLOGICAL SOCIETY, at 8.—A Revision of the Labiduridæ, a Family of the Dermaptera: Dr. Malcolm Burr.

THURSDAY FEBRUARY 3.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Relative Sizes of the Organs of Rats and Mice bearing Malignant New Growths: Dr. F. Medigreceanu.—The Thyroid and Parathyroid Glands throughout Vertebrates: F. D. Thompson.—The Transmission of *Trypanosoma lewisi* by the Rat-flea (*Ceratophyllus fasciatus*): Prof. E. A. Minchin and J. D. Thomson.—Further Evidence of the Homogeneity of the Resistance to the Implantation of Malignant New Growths: Dr. E. F. Bashford and Dr. B. R. G. Russell; The Contrast in the Reaction to the Implantation of Cancer after the Inoculation of Living and Mechanically Disintegrated Cells: Dr. M. Haaland.

RÖNTGEN SOCIETY, at 8.15.—The Essential Ambiguity of X-ray Representation, and some Methods of Solution: Dr. W. Cotton.

LINNEAN SOCIETY, at 8.—Further Discussion of the Origin of Vertebrates: Dr. A. Smith Woodward, F.R.S., Prof. A. Dendy, F.R.S., and other speakers, with Dr. Gaskell's reply.

FRIDAY, FEBRUARY 4.

ROYAL INSTITUTION, at 9.—The Heredity of Sex: Prof. W. Bateson, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction and Setting-out of a Low-level Sewer: L. T. Wilson.

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THURSDAY, FEBRUARY 3, 1910.

THE DEVELOPMENT OF GLASS-MAKING IN JENA.

Die Glasindustrie in Jena. Ein Werk von Schott und Abbe. Geschildert von Eberhard Zschimmer. Mit Zeichnungen von Erich Kuithan. Pp. 160. (Jena: Eugen Diederichs, 1909.)

THE history of the firm of "Otto Schott und Genossen" may be said to commence from the date of May 27, 1879, when Otto Schott first addressed from Witten, in Westphalia, to Ernst Abbe, professor and director of the observatory in Jena, a letter relating to some experiments he had recently been making in the production of lithium glass. He wrote:—

> "Recently I produced a glass into which was introduced a considerable amount of lithium, and of which the specific gravity was relatively low. I anticipate that this glass will show, in some direction or other, exceptional optical properties, and would ask you whether you are prepared to examine it as regards its refractive and dispersive qualities to determine whether my anticipation is correct."

The glass had been made in a small experimental furnace of Schott's design. The mixing was imperfect, and Abbe's report was to the effect that the glass contained too many striæ for optical determinations to be made. It was not long before this difficulty was surmounted, and with stirrers made from the stems of Dutch clay pipes, Schott succeeded in producing in small quantities in the laboratory experimental meltings homogeneous enough to allow of a complete determination of their optical properties. This determination, however, brought a new disappointment; for the secondary spectrum of an objective in which the crown glass of Fraunhofer was replaced by the new lithium-crown was more pronounced than before. The lithium glass, indeed, showed exceptional properties, but they were not in the direction desired.

The work was not immediately continued. A year elapsed before Abbe urged that it should be resumed. Schott thought of State aid, but Abbe, more experienced, represented the uselessness of applying for help from public funds until laboratory results of promise had been reached. In a letter of December, 1880, he suggested the main products to be desired from the point of view of technical optics.

(1) Crown glass of appreciably lower mean dispersion than that yet known, or of higher refractive index with the same dispersion.

(2) Flint glass the relative dispersion of which in passing from red to blue agrees more closely throughout the spectrum with that of crown (thus giving smaller secondary colour aberrations).

(3) Flint glass of very high dispersion, but of smaller mean refractive index.

The work was re-commenced on a more comprehensive scale. A systematic examination of glasses of varying composition was planned. To Schott, however, the procedure seemed to promise to be too protracted, and here his general chemical knowledge, and especially his acquaintance with mineralogy, served to shorten the path. Almost instinctively he fixed on the addition of phosphates and borates as the substances most likely to give glasses of novel character. As is well known, his intuition proved correct, and resulted in the foundation of a new industry. On October 7, 1881, Abbe, in sending greetings on the one-hundredth melting, writes:—"The problem of the complete achromatisation of the telescope objective I regard as solved by the two meltings 78 and 93"—two borate glasses.

The next step was the industrial realisation of the results proved possible in the laboratory. For this capital was needed, but in January, 1882, a "Glastechnisches Laboratorium" was founded in Jena by Abbe and Schott, in conjunction with Carl Zeiss and Dr. Roderich Zeiss. It was just at this time that Dr. Wilhelm Förster, director of the observatory and of the Normalaichungskommission in Berlin, was pressing that the Ministry of Finance should give State aid to an industrial research to determine satisfactory glass for the making of thermometers. In February, 1882, the Jena company became acquainted with Förster's aims. It was a matter of course that Schott should be asked to carry out the new investigation. Preceded by an examination of the varieties of thermometer glass then in use, Schott's new experimental meltings began in March, 1883, and by the end of the year promised so well that on this side also the question of the foundation of a new industrial undertaking merited serious consideration. In January, 1884, the promoters entered into new articles of association, with a capital of 60,000 marks, and, with the value of the work urged on them by various physicists of eminence, the Prussian authorities contributed, in the first two years, a further sum of 60,000 marks.

The present work was written to celebrate the twenty-fifth year of the life and development of the Jena glass works. Dr. Zschimmer's volume gives a popular account, not only of the circumstances which led to the foundation of the world-famous works, but of the technico-scientific problems which, in virtue of the researches there undertaken, have one after another been successfully solved. The relation of chemical composition to optical properties, the questions of homogeneity, durability, freedom from mechanical strain and from colour, these and all the main questions connected with the production of glass for scientific purposes are dealt with in a manner which renders them intelligible to the ordinary reader who is not specially interested in the scientific problems involved.

The processes of manufacture, the various types of furnace, the fabrication of the melting-pots, the methods of production of glass vessels of various forms, glass tubes, &c., the machinery for the production of glass bottles, the manufacture of gas-mantle cylinders, and other problems rather of a technical than a scientific character, are also dealt with. The special socialistic organisation of the undertaking—in common with that of the Zeiss firm—is shortly described.

The book is printed in a clear antique type and well illustrated with woodcuts of the style of the early days of printing, among which the excellent portrait of Schott himself calls for special mention.

THE MILLAIS GAME-BIRDS.

The Natural History of British Game Birds. By J. G. Millais. Pp. xi+142; illustrated. (London: Longmans, Green and Co., 1909.) Price 8*l.* 8*s.* net.

THE elaborate style in which Mr. Millais produces his more ambitious works renders it necessary that each should be restricted to a comparatively small group, as otherwise the price would be prohibitive to ordinary purses. In the present magnificent volume, which forms a companion to the "Natural History of the British Surface-feeding Ducks," the author has had a splendid opportunity for his artistic talents, as few birds offer finer subjects for illustration than do the members of the grouse and pheasant tribes. Not content with his own powers as an artist, Mr. Millais has secured the cooperation of Mr. Archibald Thorburn, and the combined efforts of these two great bird-painters have resulted in the production of a series of coloured and other pictures which it would be practically impossible to surpass, or even to equal, in effect, beauty of colouring, and general truthfulness to nature.

Too often artistic efforts of this kind are more or less completely marred in the process of reproduction, but in this instance Mr. Millais, as he tells us in his preface, has been fortunate enough to discover a method of reproduction which, in his opinion, far surpasses the best chromo-lithography or three-colour process. This opinion, so far as our experience permits, we are disposed to endorse; and we have certainly seen nothing to equal, let alone surpass, the frontispiece of black grouse, or the plate of red grouse in the red spring phase of plumage. In the coloured plates the birds are for the most part depicted in more or less quiescent poses; but in several of the monochrome plates we have in many instances abundance of action. Among these pictures of active bird-life, special attention may be directed to the two depicting, respectively, the courtship of the grouse and the playing-ground of the ptarmigan.

Possibly, nay probably, the expert would detect errors in some of the plates in regard to the number of primary quills in the wings; but such details would certainly not be noticed by the ordinary observer, and probably not by the majority of sportsmen; and if there be errors in this respect, as we believe there are, they in no wise detract from the general effect of the exquisite pictures. Although the price may appear high, it can scarcely be regarded as excessive for such a magnificent volume, especially when the cost of production and the fact that the issue is limited to 550 copies are borne in mind.

Probably it was the author's intention to convey to his readers all the available information in connection with his subject; but two or three points are noticeable where he has failed in this respect. We cannot, for instance, find any mention of the fact that grouse shed their claws during the main moult; neither does there appear to be any reference to the statements current in Scandinavia as to blackcock burrowing in the snow during winter. More serious is the absence of any mention of the various plumage-changes in the red-legged partridge; and in the case of nearly all the species, much more might have been written about the plumage of the chicks. In connection with partridges, the designations of "common partridge" for the grey species and "common red-legged partridge" for the French bird are by no means satisfactory; grey partridge and red-legged partridge would have been preferable and sufficient.

With the very natural tendency common to all writers of monographs to make the most of their subject, Mr. Millais uses the term British game-birds in a very wide sense, although it must be confessed that in this particular instance it is certainly a difficult matter to know where to draw the line. The red-legged partridge, for instance, is known to have been first introduced into our islands only in the second half of the eighteenth century, and yet it certainly cannot be omitted from any work on British birds. The typical pheasant likewise appears to be an introduced bird, although there is evidence that it had become completely naturalised by the time of the Norman conquest, and there can be no question as to its right to be now included in the British fauna. The introduction of the ring-necked pheasant in the early part of the nineteenth century likewise renders it difficult to exclude that species or race from the British list. When, however, we find such birds as Hagenbeck's pheasant, the Mongolian pheasant, the Prince of Wales's pheasant, the Japanese pheasant, and Reeves's pheasant figuring as British birds, we are on much more debatable ground; and if these are entitled to any mention they should not, in our opinion, have been accorded separate headings.

The author, it may be mentioned, is a strong advocate for regarding closely allied geographical forms in the light of local races rather than distinct species, and consequently classes all the birds mentioned above, with the exception of Reeves's pheasant, as local forms of *Phasianus colchicus*. No doubt there is very much to be urged in favour of this view, although when such a markedly distinct bird as the Japanese *P. versicolor* is classed as a phase of *colchicus* it seems a little difficult to know where to stop.

As we have had to mention on previous occasions, whenever Mr. Millais steps out of his proper province he invariably makes mistakes. Instances of this are afforded on p. 77 of the volume before us, where we find Pikerni for Pikermi and Œmingen for Œningen.

With the above exceptions, we have nothing but unstinted commendation to bestow on Mr. Millais's latest work.

R. L.

THE MANUFACTURE OF LEATHER.

The Manufacture of Leather. By H. Garner Bennett. Pp. xxi+420. (London: Constable and Co., Ltd., 1909.) Price 16*s*. net.

IN this work the author has attempted to produce a volume which shall be a text-book to meet the needs of candidates for the examination of the City and Guilds of London Institute, and for the degree and diploma examination of the leather students of the Leeds University. The book is also evidently written for the use of the practical tanner who possesses a limited knowledge of chemistry. We do not think that the author has been altogether successful. The proportion dealing with the scientific aspect of leather manufacture (specially noticeable in the chemistry of the tannins), and the chapter on tannage of chrome leathers, stand out in brilliant contrast with the other part of the book, particularly with the somewhat sketchy and superficial chapters dealing with the practical tanning of sole, belting and harness leathers.

The first five chapters deal with the nature of the skins, fermentation, hides and skins, and water; the author then passes to the first practical process of leather manufacture, viz. soaking, describing the various processes employed. He next deals with the various methods of removing hair and wool, together with a full description of the tools and machinery used for the purpose. Chapter viii. deals with the deliming of hides, a process which has now become universal, owing to the increased technical and scientific knowledge. In chapters ix., x., xi., the author brings together in handy form the chemistry of the tannins, the tanning materials and the methods of analysis. The next chapter deals with the preparation of the tanning liquors and the manufacture of extracts. In this, the author has gracefully glided over a very important subject, and has not dealt with many of the important changes which take place in the leaching nor dealt with some of the most recent plants devised for this purpose. The whole subject of extract manufacture is referred to in two printed pages, whereas on such an important subject as the manufacture of extract, which now forms almost 50 per cent. of the material for modern sole-leather tannage, it might have been expatiated upon at considerable length with advantage to the student.

The next chapters then deal with the tannage of sole, belting and harness leather previously referred to. In the chapters on the tannage of chrome leather but little detail has been given for the practical manufacturing process of this leather. The author then proceeds to the consideration of alum, fat, oil and aldehyde tannages, and to drying of leather, finishing of sole leather, currying and finishing of dressing leather, the dyeing and finishing of light leathers, and the finishing of chrome and other leathers. A special chapter deals with the enamelling and japanning processes and the dressing of wool rugs. This concludes the practical part of the book, at the end of which is a short chapter on the analysis of leather.

The scheme is comprehensive, but the author has failed to bring out any novel feature which has not been dealt with, at least equally satisfactorily, by other authors. The work cannot be looked upon as a standard text-book for the practical tanner, but may certainly appeal to those who, having a knowledge of practical leather manufacture, desire to study further the scientific principles.

The book is well illustrated by photographs of machinery taken from the well-known illustrated catalogues of leather trades' engineers. These do not show the essential features of the machines, but are simply photographic blocks; in no case are the essential principles of the machines described.

MEMOIRS ON MARINE ZOOLOGY.

Liverpool Marine Biological Committee's Memoirs. XVIII., Eledone. By Annie Isgrove. Pp. viii+105; 10 plates. Price 4*s*. 6*d*. net. XIX., Polychæt Larvæ. By F. H. Gravely. Pp. viii+79; 4 plates. Price 2*s*. 6*d*. net. (London: Williams and Norgate, 1909.)

THE editor—Prof. Herdman—is to be congratulated on adding these two useful memoirs to his well-known series. Miss Isgrove has given a clearly written account of a common cephalopod, for which she prefers to retain the well-known Lamarckian name rather than to adopt the name Moschites, which is its correct designation, according to the strict rules of nomenclature. In the first part of the volume interesting observations are recorded on the habits and food of this octopod, and on the conditions under which it has been found in the neighbourhood of Plymouth and Port Erin. Attention is directed to the great preponderance in number of the females, the relative proportion of the sexes of captured specimens being about fifty females to one male. In the following sections of the book the author gives an account of the external features and internal structure of the animal, considering each system of organs in turn. The morphology of the funnel, which is one of the most characteristic organs of the Cephalopoda, is worthy of more extended reference; the sections which deal with the foot and funnel contain no allusion to the homology of the latter with the epipodium of gastropods; this homology is merely parenthetically mentioned, fifty pages later, under the description of the pedal ganglia. The alimentary canal, the circulatory and excretory systems, the nervous and reproductive organs, and the spawning are carefully described, the account of the structure of the gills and the anatomy of the nervous system being worthy of special mention. In the section on the structure of the retina, the author speaks of a *nerve fibre* instead of a neurofibril, running along the axis of each retinal cell. The memoir is well illustrated by means of ten lithographic plates containing above eighty carefully drawn figures.

Mr. Gravely has essayed a difficult task, namely, to give an account of the polychæt larvæ which may be captured in the tow-net at Port Erin during the month of July. The complete identification of many of the larvæ so obtained is impossible, since their characters are totally different from those of adult worms. It is only exceptionally that such larvæ can be reared, in aquaria, to adults, and their identity definitely established. In many cases the larvæ do not present clear specific or even generic characters, and they can therefore be referred only to their respective families. The author has written a careful and detailed account, in most cases drawn from living specimens, of the principal larval forms captured, some of which have not been previously described. Measurements are given of the length and diameter of the larvæ, of some of the parapodia and setæ, and of the cilia; and the colour markings are recorded. The larvæ dealt with are as follows:—three Syllids, several Polynoids, three Phyllodocids (including Mystides and probably Eulalia), Nephthys, Spio, and four other Spionids, one of which is possibly the larva of the elusive Pœcilochætus, Polydora, and two other Polydorids, Magelona, Chætopterus, and Pectinaria, the metamorphosis, to the young adults, of the metatrochophoral larva of the last-named being described. The account of these larvæ, which is illustrated by means of forty-seven figures, will be welcome to many workers on plankton and on polychæts, and, although it is admittedly a preliminary account, it forms a good basis on which to found future observations. The reader is referred for a definition of the numerous technical terms employed in describing the different stages and larval organs to a recently published paper by the same author, but it would have been a considerable advantage and convenience to the reader if brief definitions of these terms had been given at the beginning of the present memoir.

We suggest to the editor of these memoirs that all the volumes published in the future be provided with a table of contents.

ENGINEERING SCIENCE.

(1) *Applied Mechanics, Embracing Strength and Elasticity of Materials, Theory and Design of Structures, Theory of Machines and Hydraulics. A Text-book for Engineering Students.* By Prof. David Allan Low. Pp. vii+551. (London: Longmans, Green and Co., 1909.) Price 7*s.* 6*d.* net.

(2) *Strength of Material: an Elementary Study prepared for the Use of Midshipmen at the U.S. Naval Academy.* By H. E. Smith. Second edition. Pp. ix+170. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 5*s.* 6*d.* net.

(3) *Stresses in Masonry.* By H. Chatley. Pp. viii+142. (London: C. Griffin and Co., Ltd., 1909.) Price 3*s.* 6*d.* net.

(1) THE subject covered by this book is a very extensive one, and the author is to be congratulated on the fact that by judicious compression, without sacrifice of clearness, he has in a volume of only 550 pages covered ground to which usually two or three bulky text-books are devoted. No student can expect, however, to make himself master of the contents of the book unless, as the author himself suggests in his preface, he works conscientiously through the sets of carefully thought-out problems which are given at the end of each chapter. At the end of the first, or introductory, chapter, Prof. Low has given a fairly complete bibliography for the subject, confining himself to works in the English language which have appeared during the last decade, or to those works which have been brought up to date by new and revised editions; this list will be found of considerable use by students who desire to extend their reading in any one branch of the subject.

The first five chapters are devoted to a series of introductory problems, work and energy, polygon of forces, moments and centroids, and for these latter both graphical and analytical methods are discussed; then follow six chapters on strength of materials. In the chapter dealing with compound strains and stresses, the opinion is expressed that in the case of ductile materials, such, for example, as mild steel, it is the resistance to shear which determines the strength, and reference is given to the experimental work of Guest, Hancock, Scoble, and others in investigating this problem. The whole of this chapter is well worth the careful study of the young engineer, who should not be content to leave it until he feels that he has made himself a thorough master of the principles laid down, and of the formulæ deduced for practical use in design work. Another chapter in this section which contains a well-arranged mass of information is that on the behaviour of materials in the testing machine; the latest memoirs have been summarised, and the conclusions to be drawn from these experimental investigations are clearly set forth.

In chapters xii. to xv. stress diagrams and the design of roofs and bridges are discussed, and, though of necessity there is much condensation, all the important points are clearly brought out. A student who has mastered this section will find that his work is much simplified when he comes to the study of one of the more advanced text-books specially devoted to this branch of engineering work.

The next eleven chapters are devoted to the subject of mechanism; such details as friction and lubrication, governors, toothed gearing, balancing of revolving and reciprocating masses, &c., are discussed in a satisfactory manner, and velocity and acceleration diagrams and crank effort diagrams receive due attention, though there is nothing novel in the method of treatment.

The last section of the book treats of hydraulics; the flow of water over weirs and through orifices and pipes, loss of head due to various causes, and the impact of jets on vanes are all in turn discussed, and the application of these principles to the design of such hydraulic machinery as water-wheels, turbines, pumps, and accumulators is then explained.

Prof. Low has succeeded in writing on a well-worn subject a text-book with many new features, and one which should find a place on the bookshelf of every young engineer.

(2) This small text-book was prepared for the use of the midshipmen at the U.S.A. Naval Academy in connection with one of the courses in the department of mathematics and mechanics. It deals, therefore,

only with the mathematical investigation of the subject; the experimental side is entirely omitted. The attempt to compress into one small table (p. 11) the average values of the tenacity, shearing strength, &c., of the chief materials of construction has led to the insertion of figures likely to mislead the unwary; for example, the tenacity of steel is given as 110,000 lb. per square inch; as a matter of fact, the tenacity of most of the mild steel used in constructional work lies between 60,000 and 70,000 lb. per square inch. Again, the shearing strength of wrought-iron is given as 20,160 lb. per square inch; this is much too low a figure; it is less than half the average value of the shearing strength of wrought-iron rivets and pins in double shear.

Each chapter has a series of examples to illustrate the formulæ which are deduced in that chapter, and the answers are in many cases appended; it is noticeable that these answers have a defect, by no means uncommon in text-books of this class, to which attention has often been directed, and which can best be explained by quoting a specimen answer. The student has to determine from certain data the diameter of a wooden spar used as a beam; the answer appended to the question is 7·0025 inches; of what value are the figures to the right of the decimal point? In a subject like strength of materials, one of the first lessons which the student should learn is that the numerical data which he proposes to use in some mathematical formula may, for obvious reasons, vary by some quite perceptible percentage on either side of a mean value (the value he proposes to use), and that, therefore, he can expect to obtain a solution which is only approximately correct, hence to work out a solution to the degree of accuracy of that in the example quoted above is not only a waste of time, but is positively misleading. It is to be hoped that in any future edition these answers will be revised.

The effect of combination of stresses is dealt with in chapter v. in a clear and simple fashion, and it is refreshing to find this portion of the subject taken up at such an early stage of the work, and its importance impressed upon the student.

The book concludes with a number of miscellaneous problems, such as reinforced concrete beams, stresses in thick cylinders and guns, &c.

The book will probably prove an acceptable one to young engineers who are just beginning the study of this important subject, and want to get a general insight into it before they begin to work at one of the more advanced and complete text-books.

(3) As the author points out, there are numerous elementary text-books on steel structural design, but there has been a distinct want of an elementary work on the design of masonry structures. This book will supply this need, for it explains just those underlying principles which the beginner finds it troublesome to understand.

It is difficult to follow the author's reasoning in chapter i., when deducing the safe compressive load for masonry; surely if it took 900 tons per square foot to crush a specimen of granite, there must have been a shearing stress when rupture occurred (most probably by shearing) of something like 450 tons per square foot, and, therefore, the method of deducing a safe compressive working stress given on p. 10 is hardly logical.

The branches of masonry design dealt with include walls, piers, brackets, simple arches, vaults and skew arches, domes, and retaining walls and dams; the treatment of each branch is sufficiently complete for all the practical cases the young civil engineer or architect is likely to meet with, all the more complex theories being wisely omitted.

The last chapter deals in brief fashion with reinforced concrete, the essential principles of this system being fully explained.

POPULAR NATURAL HISTORY.

(1) *Animals and their Ways. An Introduction to the Study of Zoology and Agricultural Science.* By E. Evans. Pp. viii+184. (London: J. M. Dent and Co., 1909.) Price 1*s.* 4*d.*

(2) *The Hedge I Know.* Edited by W. P. Westell and H. E. Turner. Pp. 77. (London: J. M. Dent and Co., 1909.) Price 8*d.*

(3) *The Pond I Know.* Edited by the same. Pp. 78. (London: J. M. Dent and Co., 1909.) Price 8*d.*

(4) *Butterflies and Moths shown to the Children.* By Janet H. Kelman, described by Rev. Theodore Wood. Pp. xvi+94. (London and Edinburgh: T. C. and E. C. Jack, 1909.) Price 2*s.* 6*d.* net.

(5) *Nests and Eggs shown to the Children.* By A. H. Blaikie, described by J. A. Henderson. Pp. xvi+78. (London and Edinburgh: T. C. and E. C. Jack, 1909.) Price 2*s.* 6*d.* net.

(6) *The Backwoodsmen.* By Charles G. D. Roberts. Pp. 317. (London: Ward, Lock and Co., 1909.) Price 6*s.*

(1) ALTHOUGH the title of this review of the above series of books might lead one to suppose that this book would be a popular account of the lives and habits of animals, it is unfortunately necessary to point out that such an idea would be fallacious. It is a matter of regret that the author should have chosen a title which, to our minds, does not convey a correct idea of the contents. The reason may be that we have been spoilt by the previous publication of one or two excellent little works on animal life, and that our criterion has been raised. Be this as it may, the author has not succeeded in doing justice to his theme, and we cannot imagine any young student being filled with enthusiasm for zoological science, still less agricultural science, after having had this introduction. That the author must be a botanist is evinced by such a word as "Crustaceæ" (p. 170). The illustrations are poor, Fig. 3 being especially crude; and an acknowledgment of the source of such figures as are taken from the publications of the U.S. Department of Agriculture, which are good, should surely be given under the figures, as is customary.

(2 and 3). These small books of the same series are marvellous examples of cheap printing, and are unaccompanied by the usual inferior illustrations; they are well illustrated, and, on the whole, are written in simple language. It probably would have been pre-

ferable to have substituted the description of a stickleback for that of a pike in the fauna of the pond as being more characteristic. We should think it rather doubtful whether most children (or grown-ups) would identify the frontispiece of the first of these two books as a hedge, nor should we wish the statement on p. 32 of the same book, that the "sap escapes and takes the form of curiously moss-like growths," to be taken as scientifically accurate by the student of natural history.

(4) Who could describe the butterflies to our children better than the Rev. Theodore Wood, who has done so much to popularise natural history among the young? We should expect that he would do it excellently, and are not disappointed in this little book, which is one of the best of the series. With the exception of one or two of the caterpillars, the illustrations are excellent, as is essential in a book of this nature, where a good coloured figure is so important; for no child could identify a butterfly correctly and with ease from the best of written descriptions.

(5) In describing the eggs of birds to the children it is an excellent idea to associate the nests with the eggs. Children do not dissociate the two to the extent that many older persons in the past have been accustomed to do. To a child as yet unspoilt by the collecting fever characteristic of youth, the nest is as important as the eggs it contains, and this small book will serve as an excellent guide to those budding observers to whom the finding of a nest is an object of interest and pleasure.

(6) Strictly speaking, this book, which is a collection of tales of the backwoods of Canada, does not come within our province; nevertheless, the author is so keen an observer of nature, and so well known as an ardent follower of the "call of the wild," that some of his tales are full of life and interest, and form excellent "light reading."

C. GORDON HEWITT.

OUR BOOK SHELF.

Recent Advances in Physical and Inorganic Chemistry. By Dr. A. W. Stewart. With an Introduction by Sir Wm. Ramsay, K.C.B., F.R.S. Pp. xiv+267. (London: Longmans, Green and Co., 1909.) Price 7s. 6d. net.

THE present volume is a companion to the author's book entitled "Recent Advances in Physical Chemistry." The issue of two such books by the same author affords a fair gauge alike of their merits and of their demerits. At the present time, no one writer can possibly be a master of organic, of inorganic, and of physical chemistry, and the criticisms that are offered by the author cannot, therefore, be regarded as having more than a superficial value. On the other hand, the production of a second volume so soon after the publication of the first may be taken as evidence of a considerable popular demand, and shows at least that a book of this type was called for by a wide circle of readers. In the circumstances, it is to be regretted that the publishers did not follow out the plan they have adopted in their excellent "Text-books of Physical Chemistry" and in their "Monographs on Biochemistry" of securing a series of articles by authors who have themselves worked on the subjects which they discuss. A volume compiled on these lines would have been of real value and undoubted usefulness.

In the present instance the author has rendered a service to the student who is working for an honours degree by presenting in a compact form the main results of certain lines of research which have been carried on in recent years, and may from time to time form the subject of examination questions. These investigations can only be mastered by a toilsome perusal of the original literature, and every attempt to reduce the labour involved in this task is sure of a welcome alike from the student and from the teacher. The danger of all such attempts is that the reader may acquire the indolent habit of obtaining his information in this easy way from second-hand sources, and so lose the stimulus and the opportunity of independent judgment which come from a perusal of the original text. On the whole, however, if the work is adequately carried out, the balance of advantage is in favour of the method of summarised presentation, and as the bulk of chemical literature becomes more and more unwieldy, the production of these summaries will become increasingly important. On these lines, Dr. Stewart's volume may be sure of a welcome and a considerable circulation.

(1) *The Elements of Mechanics of Materials. A Text-book for Students in Engineering Courses.* By C. E. Houghton. Pp. viii+186. (London: Constable and Co., Ltd., 1909.) Price 7s. 6d. net.

(2) *Experimental Mechanics for Schools.* By F. Charles and W. H. Hewitt. Pp. vii+288. (London: G. Bell and Sons, 1909.) Price 3s. 6d.

(1) IN this elementary text-book the engineering student is provided with a clear and concise account of the practical applications of mechanical principles to the design of simple machine parts and common structures. The first two chapters deal with the properties of materials as disclosed in the experimental laboratory, and with the strengths of tie-rods, cylinders, and riveted joints. Succeeding chapters relate to the strength and stiffness of beams, shafts, struts, and composite structures, including reinforced beams and columns; there is also an investigation of the effect of combined stresses. The most valuable parts of the book are the excellent collections of review questions and illustrative problems with which each chapter closes. These are very suggestive, well graduated, and eminently practical, and will be greatly appreciated by students and teachers alike. The author writes for those students who have only time for a very cursory study of the theory of elasticity, so that the limitations of the various formulæ are scarcely considered. The book will serve a very useful purpose, and will afford great assistance in some parts of practical design.

(2) Messrs. Charles and Hewitt describe or suggest a large number of simple experiments illustrating the principles of mechanics, and give extensive sets of examples in which these principles are enforced and applied. They constitute a mine from which teachers may select such details as are suitable for their own particular circumstances. The earlier experiments are statical, and deal with forces at a point, parallel forces, and friction, and illustrate the principle of the parallelogram and of the lever. A boy easily understands the action of a force because he employs his muscles every day to exert forces. The actions of couples remain more or less of an abstraction, for he seldom applies them. The authors have overlooked the need there is in the laboratory for the frequent muscular application of torques, measured by angular displacements in a simple torque meter placed between the hand and the apparatus.

Experiments in dynamics succeed those on statics, in which velocity, acceleration, inertia, work, kinetic energy, and centrifugal force are measured. The properties of vectors are here developed, though not so fully as might be desired, and occasionally there is a vagueness of language which must give trouble to a student who tries to think clearly.

Remaining chapters deal with the efficiencies of simple machines; the application of the link polygon; the drawing of reciprocal figures for jointed plane frames; and the determination of Young's modulus and of moments of inertia. In addition to the examples appended to each chapter, the authors give, at the end of the book, more than three hundred miscellaneous examples, and copies of recent examination papers, both theoretical and practical. A good index is provided, and teachers will find this book very helpful indeed.

Air and Health. By R. C. Macfie. Pp. vii+345. (London: Methuen and Co., 1909.) Price 7*s.* 6*d.* net.

THIS is a very readable work, containing much useful information. As the subject is dealt with in a manner which renders it interesting and easy of comprehension, even to people who may have no acquaintanceship with chemistry and physics, it should appeal to a wide range of readers; but it will prove of special service to the medical student of hygiene and preventive medicine, and the medical writer doubtless had this end mainly in view. The subject of the CO_2 respiratory impurity in the atmosphere is treated at some length. In this connection the author states (p. 133) that "Anyone who compares his power of mental work in a pure and in a CO_2 laden atmosphere, even if the latter be dry and cool, will find in the latter a considerable diminution, showing that at least nerve metabolism is affected." This statement implies that the CO_2 in a badly-ventilated room (as ordinarily understood) is capable, *per se*, of producing results which more recent experimental work demonstrates to be due to the combined effects of the altered physical conditions of the air—the increased moisture and temperature, in a stagnant atmosphere. The important subject of the composition, &c., of sewer air is inadequately discussed in eight lines.

Mr. Spence's suggestion that all the smoke of a city should be conducted by the sewers to a few enormous chimneys, where it could be completely burnt (p. 155), appears to be commended by the author. Certainly Sir B. W. Richardson proposed to adopt this method in his model city of Hygeia, but it is inconceivable that it could be efficiently applied. The various methods of freeing air from trade dusts and gases might have been included with advantage in such a work, and the volume seems incomplete without some reference to analytical methods—even if the reference were confined to the more simple practical tests for the more important gaseous impurities of the atmosphere of dwelling and working rooms.

But notwithstanding these deficiencies, the matter is, generally speaking, so well dealt with that the work may be confidently recommended for study and reference purposes.

The range of treatment embraces eighteen chapters. These deal with the composition of air; the discovery of the atmospheric gases; respiration; air-pressure in relation to life; the temperature, humidity, and thermolysis of air, and health; air and solar radiation; electricity and radio-activity, and their relation to climate; impure and polluted air; dust and germs; ventilation, draughts, and "colds"; artificial atmospheres; the open-air treatment of consumption; and open-air schools.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Natural History Museum.

IN reference to the article on the Natural History Museum in NATURE of January 20 (p. 343), in which Sir Archibald Geikie is represented as saying that the questions put to him in the letter from the Speaker of the House of Commons "were entirely in reference to the relations between the Trustees and the Museum," historical accuracy demands that it should be stated that the questions of Mr. Lowther were two in number (see NATURE, December 16, 1909, p. 196). They were:—(1) "Whether the Board of Trustees, acting through its Standing Committee, is in your judgment the best authority for the government of such an institution as the Natural History Departments of the British Museum?" and (2) "Whether, under the existing statutes and rules, the scientific management of the Natural History Museum suffers any detriment from its association with the Museum at Bloomsbury?"

It is clear that in his communication to you Sir Archibald Geikie has overlooked Mr. Lowther's second question, with which alone (so far as these two questions are concerned) the present agitation has concerned itself. We have always admitted that "a system of control by Trustees is the best" (see NATURE, December 30, 1909, p. 254). You were therefore quite right in your impression that the main point of contention was the complete separation of the governance and administration of the Natural History Museum from the other collections in the British Museum. Mr. Carruthers's letter does not touch the point at issue, except in so far as it seems to show that Prof. Huxley was in agreement with our view that "a system of control by Trustees is the best." He says nothing to show that Prof. Huxley came to disagree with the conclusion to which he had twice put his signature, once after a prolonged inquiry by Royal Commission, that it was of fundamental importance that the governance and administration of the two Museums should be separate.

A. SEDGWICK.

2 Sumner Place, S.W., January 30.

Markings on Mars as seen with Small and Large Telescopes.

THAT large telescopes are liable to less accurate definition of planetary markings than small ones can easily be verified in the following manner, and tested for any given occasion. The spurious disc and rings made of a star by a telescope is a real image, due to the interference of the light-waves—as real an image, although produced by a different cause, as that of a planet's disc with its markings. If atmosphere and glass be perfect, the image consists of a round disc, encircled by concentric and continuous rings of light. The only difference in the image with different apertures is that the larger the aperture the smaller the disc, and the closer and thinner the rings. If this image assume any other form, it is either because the objective is poor, which is commoner with objectives than is supposed, as Hartmann's tests have shown,[1] or because the seeing is defective. In proportion as the seeing is bad the rings of the image begin to waver, then break up into fragments, a sort of mosaic, and finally end in an indiscriminate assemblance of points. In certain kinds of bad seeing the parts may seem quite steady, but that the mosaic exists is proof positive of poor seeing.

Now this image as made by different apertures may be compared either by observing with different telescopes at the same place and time or by diaphragming down a large objective. When this is done it becomes at once evident that the smaller aperture always gives the more accurate definition of the optical disc and rings in spite of the theoretical greater resolvability of the larger glass. If, now, under the same conditions of seeing in which the rings appear continuous—their real form—in the smaller glass, the aperture be increased, the rings will be seen to break up into detached masses. It is very rare that they ever appear otherwise in a very large glass, for the seeing is almost never good enough thus to show them, accuracy of definition demanding much better air for a large than for a small aperture.

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[1] The Lowell Observatory glass has been tested by this method, and proves to yield the best images of any yet examined. (Bulletin in preparation.)

Now what happens to the lines of the image of a star—for the rings are simply circular lines—must happen in the same manner to planetary lines. They too must break up into a mosaic in a large glass whenever the rings do. This shows that planetary lines would necessarily assume a mosaic in a large glass contrary to their true form of continuous linearity.

Percival Lowell.

Lowell Observatory, Flagstaff, Arizona.

Colour-blindness.

In the summary of the case of Mr. John Trattles published in Nature of January 27 the expression is used:—"Dr. Ettles, who had examined Mr. Trattles, and was of opinion that he was not colour-blind, was also present."

That is only relatively accurate, and it is in the reservation that the real point lies. I examined Mr. Trattles on May 10, 11, and 12 last year. His spectrum range included both B and H lines—actually, 0·75 μ in the red to 0·39 μ in the violet. His sense of colour was less good about 0·54 μ than in the rest of the spectrum. Indeed, it was what one might call "bad." It was the presence of this defect which caused him to give such contradictory replies at Sir Wm. Abney's examination. My certificate, which was read in the House of Lords by Lord Muskerry in the debate referred to, viz. June 30, 1909, expressly stated that Trattles was competent to navigate a ship. It did not state that his colour vision was in all respects perfect.

Sir Wm. Abney and those associated with him concluded that, as the result of their tests, Trattles was "completely red-blind." I saw in those tests simply a confirmation of my own conclusions. We were at one in the symptoms, but we strongly differ in the diagnosis. If the Board of Trade starboard light were a yellow-green, Trattles would be unfit; but it is a blue-green, and he sees it perfectly.

As to red, he is anything but scoterythrous; that is what comes of being obsessed with a colour-vision theory.

One other point, the "recondite test of simultaneous contrast colours" is very much open to criticism. A simultaneous colour contrast is not a "colour" in the ordinary sense; it possesses no dominant wave-length; it is an optical illusion. Is an optical illusion so accepted and clear a test that it may be used as a touchstone to determine whether a man's career shall be ruined or not?

William Ettles.

34 Wimpole Street, Cavendish Square, W.,
January 30.

We regret that we were in error in stating that Dr. Ettles was of opinion that Mr. Trattles was not colour-blind. It is interesting to know that he found the colour vision "less good" at a point in the spectrum not far removed from the region where the so-called "red-blind" person has a so-called "neutral band." The accurate determination of the spectrum range and of the deviations from the normal within that range constitutes the fundamental problem in discriminating colour-blindness. The accuracy of the determination, however, depends upon the methods adopted and the precision of the application of these methods.

With regard to the simultaneous contrast test, Dr. Ettles states that it is an optical illusion. If this be admitted, it is constant in its character in all normal individuals; hence any deviation may be fairly regarded as indicating a pathological condition of colour vision. As physiologists we cannot admit as a valid argument against the test that it is difficult or impossible satisfactorily to correlate the physical facts with the physiological manifestations.

But is it necessary or advisable that the divergence of opinion on the exact conditions of Mr. Trattles's colour vision should be further emphasised? The case has been adjudicated upon, and has amply demonstrated the need of reform either in the tests or in the application of the tests. The Board of Trade cannot, and ought not, to accept *any* risk of allowing a man with possibly dangerous defective colour vision to pass the examination. It is better that slight hardship should fall upon a few individuals than that many lives should be endangered; but the hardship must be minimised, and this object will be best attained by ensuring that the individuals shall be eliminated as early as possible in their careers. Hence it is of the utmost importance that the first examination shall be authoritative and conclusive.

The Writer of the Article.

Records of the Earthquake of January 22.

On January 22 the Kew Milne horizontal pendulum recorded a large earthquake, of which the preliminary tremors commenced at about 8h. 52·6m. a.m., and the large waves at about 8h. 56·1m. The limits of registration, 17 mm., were exceeded between 8h. 58m. and 8h. 59m., and again at 9h. 0·4m. Synchronous with both maxima there were burrs on the magnetic declination trace. The largest, which simulated an oscillation of 1·5′ in declination, commenced about 8h. 57m., and lasted about five minutes. The movements on the declination trace were unquestionably seismic in character, and represented the mechanical effect of the principal earth tremors. The horizontal and vertical force traces were not sensibly affected.

Charles Chree.

The National Physical Laboratory (Kew Observatory Department), Richmond, Surrey, January 27.

An Earthquake Phenomenon.

A curious phenomenon connected with the earthquake of January 22 was that the maximum movement was accompanied by a sudden tilt. The amount of this was approximately one second of arc, its direction being towards the north-west. This would correspond to a rise of the ground on the south-east. It took place at about 8 a.m., when the booms of five horizontal pendulums were suddenly displaced from their normal position. Those oriented east and west were swung to the north, whilst those at right angles moved to the west. Pendulums in rooms 80 yards apart were displaced similarly. From 12.45 they crept back somewhat intermittently towards their original position, which they reached about 4 p.m.

Whether this indicates a local change in the dip of the strata (chalk) on which my instruments are founded or a more extended change of level cannot be stated with any certainty. At Bidston a pendulum oriented east-west was displaced towards the north, and at West Bromwich a pair of pendulums swung more on one side of their normal position than on the other. Their behaviour suggested a displacement similar to that observed at Shide. Permanent changes in the ground near the origin of a large earthquake are common.

J. Milne.

Shide, Isle of Wight.

The Preparation of Silicon. A Warning.

A common method of preparing silicon is by mixing silica and magnesium powder in molecular proportions and heating until the following reaction takes place:—

$$SiO_2 + 2Mg = Si + 2MgO.$$

The majority of text-books recommend the use of silica in the form of silver sand or ground quartz, but they do not say it is absolutely necessary, or even desirable, that it should be in this form, and one well-known treatise states that precipitated silica and pure magnesium powder will yield very pure silicon. This authority adds that if the experiment is performed with precipitated silica the reaction is attended by a brilliant flash of light.

Having recently had occasion to prepare some silicon, precipitated silica was heated with magnesium powder in a Hessian crucible. One quarter gram-molecule of each was employed. The heating had proceeded some little time when suddenly the mixture exploded with terrific violence, shattering the crucible to a powder and sending out a great sheet of white flame. So great was the force of the explosion that the iron ring of the retort stand which held the crucible was bent out of shape. On examination it was found that the ingredients were pure, except that they might not have been quite free from moisture.

What I wish particularly to point out is that there is not a word in any of the text-books I have referred to of the danger of a very serious explosion in the above preparation.

Perhaps someone can say, definitely, whether the presence of a trace of water will cause such a mixture to explode on heating.
F. H. Power.

Lincoln Grove, Radcliffe-on-Trent, Notts,
January 26.

Intermittent Glow of the Tail of the New Comet.

In Mr. Rolston's interesting and valuable article on the new comet (Nature, January 27) reference is made to the statement of the Rev. F. J. Jervis-Smith that several persons observing at Lymington on January 22 thought the tail appeared to flash slightly and continuously.

Now, on the evening of that day I got the impression, on seeing the comet setting in the west-south-west, that there was an intermittent glow of the tail matter, in no very marked degree, it is true, but still there was a seeming perceptibility.

Later that evening I was told by an unskilled observer that he had seen "faint lights issue from the head and pass up to the end of the tail."

The conclusion I came to at the time exactly coincides with that referred to in the article, which is that the appearance was referable to the low position of the object and consequent atmospheric effects.

The interposition between the observer and the tail of a slight cloud or of some distant mass of smoke, though in itself too filmy to be noticed from afar off against a dark sky, would, doubtless, account for these light changes.

A correspondent once wrote to me—in some alarm, I thought—that Jupiter had on the previous evening behaved in a manner which was, to say the least, extraordinary, in that it had "kept going in and out" for five minutes on end. As the planet was then low in the sky, I concluded that the effect described by my perturbed correspondent was due to rapidly moving patches of unseen denser vapour than that which surrounded the planet, intruding in the line of sight. At the same time, I was far from being unmindful of the way in which Jupiter's light will frequently palpitate when the planet is nearing the horizon.
J. H. Elgie.

72 Grange Avenue, Leeds, January 28.

Unemployed Laboratory Assistants.

A number of lads who have been employed as laboratory monitors in secondary schools, and whom the London County Council are unable to retain in their service beyond the age of sixteen years, have been referred to us by the London County Council with the view of our placing them. Some of them we have already been able to place in suitable employment, but there are still one or two on our books for whom we seek situations.

They all have an elementary knowledge of physics and chemistry. Some have learned glass-blowing and bending, and one of the applicants has already passed the Board of Education examination in chemistry (Stage I.). If any readers of Nature would like to have further particulars of these boys, I should be glad to supply them with information.
Godfrey Reiss (*Hon. Sec.*).

Apprenticeship and Skilled Employment Association,
36 Denison House, 296 Vauxhall Bridge Road,
London, S.W., January 31.

THE AROLLA PINE.[1]

The Arve or Arolla pine is the most beautiful of Alpine conifers. The glossy green of its acicular tufted leaves, the curving cone of its outline, the combined strength and grace of its growth, make it yet more attractive in colour and in form than the darker and sturdier spruce. It ranges, though rather fitful and sporadic in distribution, throughout the Alpine chain, passing on to the Carpathians, where, however, it does not grow nearly so high above the sea-level, but it is most abundant in north-eastern Asia, which is apparently its birthplace. There it extends northward to the tree-limit, eastward to the Altai, the Sea of Okhotsk, and the north of Japan, and westward even so far as the Lower Dwina. Between the occupants of these two provinces some marked differences exist, so that Dr. Rikli recognises an Arctic and an Alpine subspecies, to the latter of which his memoir is restricted. The Arve is a lover of the mountains, and on these it has a rather wide vertical range. When growing wild it is seldom met with below the 1350-metre contour-line. Dr. Rikli mentions as the lowest instance one at about 1200, near Raron, in the Upper Rhone valley. Its upper limit is about 2400 metres, the highest occurrence on record being 2585 metres, on the Plattje, near Saas Fee. Such cases, however, are exceptional, where the tree obviously has had a hard struggle for existence, and it cannot be said to flourish above 2300 metres. On the Northern range of the Alps, the vertical limits within which it grows freely are narrower than in the Central—or Pennine and Lepontine—range, the difference between them, in

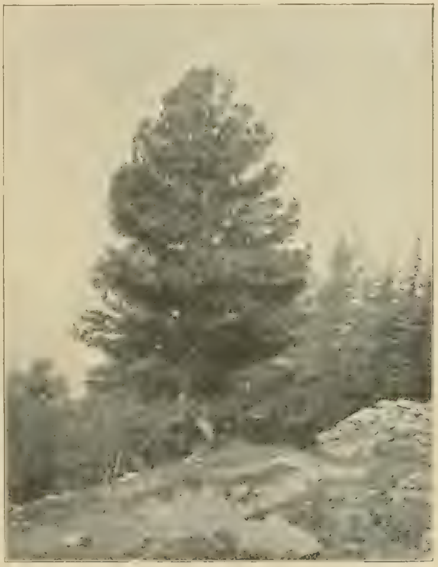

Fig. 1.—The Arve in Youth.

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[1] Die Arve in der Schweiz. Ein Beitrag zur Waldgeschichte und Waldwirtschaft der Schweizer Alpen von Dr. M. Rikli. Mit einer Arvenkarte der Schweiz, einer Waldkarte von Davos, 19 Specialkarten in Lithographie, 9 Tafeln in Lichtdruck und 51 Textbildern. (Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft, Band xliv.) Pp. xl+455. (Basel: Georg & Cie.; Zürich: Zürcher & Furrer, 1909.)

Canton Valais, being 1385 metres, and in Canton St. Gall only 270 metres.

Sometimes these pines form distinct and close-grown woods, to the exclusion of other conifers, in which each one is similarly developed. Such woods, however, are not common, and are generally restricted to the Grisons and Canton Valais, where the Arve is most abundant. More often, however, even when not mixed with other kinds, individuals grow either in more open order or in small clusters, or even as solitaries. On the slopes of the northern Alps they not unfrequently form trailing lines, the trees in which, as might be expected, often bear the marks of storm and stress. But the Arve more commonly is associated with other conifers—the larch, the spruce, the Scotch fir, and sometimes the silver fir. Another, but more lowly companion, is the Legföhre (*Pinus montana*), that trailing conifer which is more abundant in the eastern than in the western Alps, and altogether absent, so far as Dr. Rikli knows, from the Valais and the Oberland. The Arve also grows in company with other trees and bushes, such as the birch, the beech, the Alpine alder, a service (*Sorbus aucuparia*), and, of course, with the common rhododendron (*R. ferrugineum*), the bearberry (*Arctostaphylos uvaursi*), the bilberry (*Vaccinium myrtillus*), and another member of that genus; while in the associated flora a mid-Europe Alpine, a north-Europe Alpine, and an Arctic-Altaian element may be detected; the last, as Dr. Rikli remarks, forming a link with the Arve's original home.

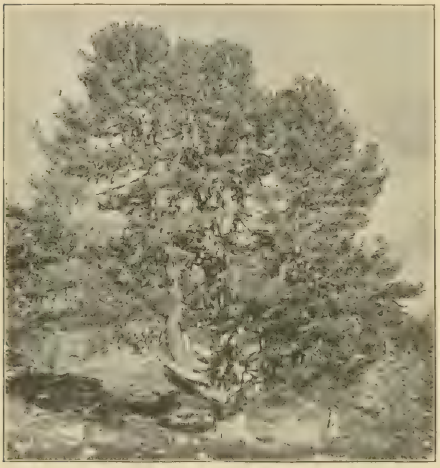


FIG. 2.—The Arve in Age.

This memoir describes, with illustrations from reproduced photographs, the modes of growth which, according to circumstances, the Arve exhibits. A solitary one, when in its full vigour, is a happy combination, as Fig. 1 proves, of beauty and strength. With the advance of age it is apt to lose its symmetry and compactness, though it is still, as Fig. 2 shows, an ornament to the landscape. No more than other trees does it escape being torn by the storm or the avalanche, shattered by the lightning, and nipped, especially when young, by exceptionally severe frosts; but when overthrown, it sometimes puts out new roots and converts side branches into leading stems. But the Arve has its enemies also among other living things. Man is responsible for reckless hacking and felling, for forest fires or damage done in climbing after its cones, the kernels in which have a nut-like flavour. But now that he is restrained by forest laws, other creatures are the more formidable. Goats, sheep, and cattle (especially the first, if carelessly tended) do much damage to the young plants; the roe-deer, the stag, and the chamois take their share when in search of food. The marten, the squirrel, and even the fox, feed on the nuts, though the last, like the wood and hazel mice, must wait until they have fallen. Some birds also have similar tastes. Most conspicuous among these is the nutcracker (*Nucifraga caryocatactes*), which is never so common in the Alps as where the Arve is plentiful and its fruit is ripening. The capercaillie (*Tetrao urogallus*) feeds on the young shoots, and the common sparrow, generally to the front in mischief, has been known to do the same with seedlings. Its insect foes we can only mention.

In short, Dr. Rikli seems to have touched on every point of interest in the life-history of *Pinus cembra* in Switzerland, and has done his work with Teutonic thoroughness. He goes over the country, canton by canton, and valley by valley, citing statistics of the numbers of the trees, their distribution on either slope, and other distinctive features; he gives many particulars of the age, size, and rate of growth of the older trees, and refers to the care which, of late years, has been bestowed on their culture. The maps appended to the volume are interesting as showing the relative abundance or scarcity of *Pinus cembra* in different districts of the Alps, and the numerous photographs, especially the eighteen separately printed, some of which are unusually good, recall to lovers of that mountain chain pleasant memories of this handsome tree. To such Dr. Rikli's work will always be attractive; but to students of forestry it will be indispensable. T. G. B.

ON HALLEY'S COMET AS SEEN FROM THE EARTH.

THE following table gives ecliptic coordinates of Halley's comet to two decimal places at intervals of four days through an arc extending from one end to the other of the *latus rectum* of its orbit. The zero of time is very nearly the moment of perihelion passage, and the figures apply approximately to any return.

Day	x	y	z	Day	x	y	z
−52	+0·95	+0·73	+0·12	+4	+0·21	−0·54	+0·15
−48	+0·93	+0·64	+0·13	+8	+0·10	−0·59	+0·13
−44	+0·91	+0·55	+0·14	+12	−0·02	−0·64	+0·11
−40	+0·89	+0·46	+0·15	+16	−0·13	−0·67	+0·09
−36	+0·86	+0·37	+0·16	+20	−0·24	−0·69	+0·06
−32	+0·83	+0·27	+0·17	+24	−0·34	−0·70	+0·04
−28	+0·80	+0·18	+0·18	+28	−0·45	−0·71	+0·01
−24	+0·75	+0·08	+0·18	+32	0·55	−0·71	−0·02
−20	+0·70	−0·02	+0·19	+36	−0·64	−0·70	−0·04
−16	+0·65	−0·12	+0·19	+40	−0·74	−0·70	−0·07
−12	+0·58	−0·21	+0·19	+44	−0·83	−0·68	−0·09
−8	+0·50	−0·31	+0·19	+48	−0·91	−0·67	−0·12
−4	+0·41	−0·39	+0·18	+52	−1·00	−0·65	−0·14
0	+0·31	−0·47	+0·17				

The comet attains unit distance from the sun thirty-nine days before and after perihelion passage. On the former occasion its z coordinate perpendicular to the ecliptic is +0·15, on the latter −0·07. It is evident, therefore, that the closest possible approach to the earth will occur after perihelion passage. The heliocentric longitude is 30° on the earlier occasion and 225° on the later. The earth reaches these heliocentric longitudes in October and May respectively.

At the return of 1835 perihelion passage was on November 16. There was consequently a close approach between the earth and the comet about a month earlier. In 1910 the perihelion passage will be on April 20; a month earlier than this, when the comet is close to the earth's orbit, the earth will be at the diametrically opposite point. A month after perihelion, however, there will be a very close approach.

The most unfortunate date for perihelion passage for yielding a close approach to the earth is January. The comet would then be behind the sun at perihelion, and more than an astronomical unit away when crossing the earth's orbit.

On the present return the approach after perihelion will be unusually close. The following table gives the ecliptic coordinates of the earth for the annexed dates:—

Date		x		y
1910, May 10	...	−0·65	. .	−0·76
,, 14	...	−0·60	. .	−0·80
,, 18	.	−0·55	...	−0·84
,, 22	...	−0·49	...	−0·87
,, 26	...	−0·43	...	−0·90
,, 30	...	−0·37	...	−0·93

When, therefore, the comet crosses the plane of the ecliptic twenty-eight days after perihelion passage (May 18) it will be almost exactly between the earth and the sun, and the earth will probably be in the tail of the comet.

The closest approach at this return takes place a day or two later.

The closest approach possible would correspond to a perihelion passage about a week and a half earlier in the year than the present one.

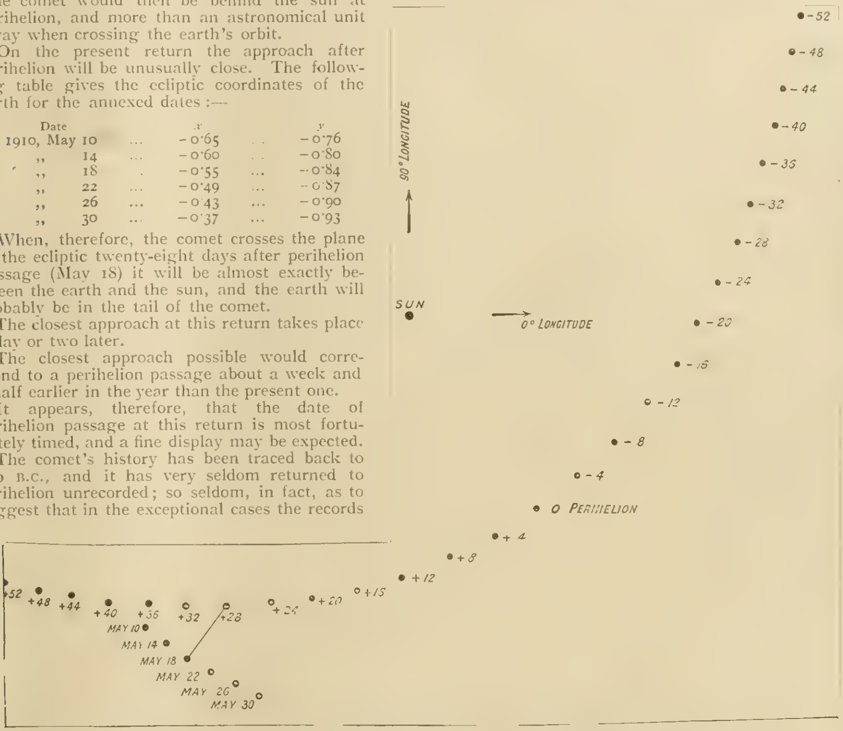
It appears, therefore, that the date of perihelion passage at this return is most fortunately timed, and a fine display may be expected.

The comet's history has been traced back to 240 B.C., and it has very seldom returned to perihelion unrecorded; so seldom, in fact, as to suggest that in the exceptional cases the records have perished rather than that the comet in any circumstances can pass by unseen.

A tail twenty or thirty degrees in length is expected on the present occasion. It will be best seen at the end of May, and in England it will, unfortunately, be lower in the sky than in more southern latitudes. There will, however, be no difficulty whatever in seeing it in England, unless there is a prolonged spell of bad weather.

The approach to the earth is so close that an American astronomer has conceived the idea of weighing the comet by the deviation it produces in the orbit of the earth. We can hardly believe that the effect produced will be one-thousandth part of the least measurable quantity, but the speculation is most interesting in view of the fact that there are unexplained phenomena in planetary movements.

P. H. Cowell.



The diagram gives the position of the Earth for six days in May; also the position of the comet on twenty-seven dates measured from perihelion passage in days. The line of sight is drawn for May 18, twenty-eight days after perihelion, when the comet transits across the Sun.

JUBILEE OF THE THEORY OF ELECTROLYTIC DISSOCIATION.[1]

In his address to the British Association in 1884, the president, Lord Rayleigh, said, "from the further study of electrolysis we may expect to gain improved views as to the nature of chemical reactions, and of the forces concerned in bringing them about. . . . I cannot help thinking that the next great advance, of which we have already seen some foreshadowing, will come on this side."

The first step of the advance spoken of by Lord Rayleigh had already been made, for in that same year the young Swedish physicist, Arrhenius, presented as his doctor's dissertation to the University of Upsala a memoir with the title "Recherches sur la Conductibilité galvanique des Électrolytes. Première Partie: La Conductibilité des Solutions aqueuses extrêmement diluées," which was published in the "Bihang till Kongl. Vetenskapsakademiens Handlingar," vol. viii., and was followed in the same year by the second part, entitled "Théorie chimique des Électrolytes." These researches contain the germ of the theory of electrolytic dissociation, which, however, only received its complete statement in 1887, in the first volume of the newly founded *Zeitschrift für physikalische Chemie.*

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[1] *Zeitschrift für physikalische Chemie.* Bd. 69, Jubelband. Svante Arrhenius zur Feier des 25-jährigen Bestandes seiner Theorie der elektrolytischen Dissociation gewidmet von seinen Freunden und Schülern. Mit einer Einleitung von W. Ostwald. Pp. xxix+685. (Leipzig: W. Engelmann, 1909.)

The impression made on the university authorities by Arrhenius's thesis was not favourable. In their view, apparently, it was neither very good chemistry nor very good physics, and only deserved the mild commendation "non sine laude approbatur." Indeed, the fundamental conceptions of the new theory were so much at variance with the current ideas of both physicists and chemists that it can scarcely excite wonder to find that a strenuous opposition was offered to the introduction of the notion of free ions into science. Had it not been for the warm advocacy of Ostwald, who was already a power in the domain of physical chemistry, it is not at all unlikely that the theory would have remained in abeyance (as did Avogadro's hypothesis for nearly fifty years) until the necessity for it became imperative.

Happily, however, for the progress of science, the appearance of the theory synchronised with that of van 't Hoff's theory of osmotic pressure, which it supplemented by accounting for the apparent abnormalities displayed by electrolytic solutions. Armed with these two powerful weapons, Ostwald, by his writings, by his researches, and not least by his establishment of a school of physical chemistry in Leipzig, where, under his stimulus, the theories were practically applied by his pupils to the elucidation of numerous problems in the physics and chemistry of solutions, gradually overcame effective opposition, and secured a permanent, if somewhat reluctant, recognition of the new ideas. To this period belongs the fundamental application of the two theories by Nernst to the calculation of electromotive forces. The only parallel in physical chemistry to the activity and fertility of those days is to be found in the contemporary development of radio-active research.

We occasionally hear it said at the present time that the theory of electrolytic dissociation is "played out," that it was useful for a season, but that it must now be superseded by something different and better. Not many years ago, similar statements were made regarding the kinetic theory of gases—that it had served its purpose, was very good so far as it went, and might be peacefully left to die a natural death. To-day the kinetic theory is far from moribund, and it seems to the present writer that a corresponding vitality is inherent in the theory of Arrhenius. Wide-reaching and fruitful physical theories generally contain a well-defined notion which survives any change of form which the theory or its mechanical interpretation may undergo. Dalton's atomic theory contains the imperishable notion of fixed combining weights for the elements; Avogadro's theory contains the definition of molecular weight; and from these two together we obtain, as Cannizzaro showed, the modern atomic weight. Whether we believe in atoms and molecules or not, these conceptions of combining, atomic and molecular weights will persist unaltered, and survive any upheaval in chemical theory. Similarly, Arrhenius's great positive contribution to physico-chemical science is the notion and practical definition of degree of ionisation. Whatever be our views of the origin and nature of ions, we must, in any quantitative investigation of the properties of electrolytic solutions, have recourse to the notion of degree of ionisation.

Arrhenius has since been active in many fields besides that of physical chemistry, notably in cosmic physics and in serum-therapy, bringing to bear in these branches of science the same clear-headedness and sublimated common-sense which enable him in the multiplicity of the details he so easily masters to detect the simple principles which coordinate and govern the whole. The present volume, however, the sixty-ninth of the journal which in its first volume contained the statement of his theory, is only concerned with his physico-chemical work, and is the first of two volumes written in his honour by pupils and friends to signalise the completion of the fiftieth year of his age and the twenty-fifth of his theory. To it physical chemists in all parts of the world have contributed, testifying to the universal esteem in which Arrhenius and his work are held, and a fitting introduction is written by Ostwald, who relates the early history and development of the theory with many pleasant biographical and autobiographical details.

JAMES WALKER.

PROF. F. W. KOHLRAUSCH.

It is with great regret that we have to record the death of the eminent physicist, Prof. F. W. Kohlrausch.

Kohlrausch was born in October, 1840, at Rinteln on the Weser. His father, Rudolph Kohlrausch (1809–1858), was a physicist of great distinction who, in conjunction with Wilhelm Weber, carried out for the first time a determination of the ratio of the electromagnetic to the electrostatic unit of electric quantity, and thus laid one of the corner-stones of the absolute system of electrical measurement. It was, therefore, natural that the son's attention should be early directed towards physical science. He studied at Göttingen and Erlangen, graduated Ph.D. in 1863, and in 1866 was appointed Professor Extraordinarius at Göttingen. After about a year as professor of physics at the School of Technology at Frankfort-on-the-Main, he was appointed, in 1871, to a similar post at the Grand-ducal Polytechnic at Darmstadt. In 1875 he became professor of physics in the University of Wurzburg, and was transferred thence to Strassburg in 1888. He was appointed president of the Physikalisch-Technische Reichsanstalt at Charlottenburg in 1895, and, in the same year, was elected a member of the Academy of Science of Berlin and also a Foreign Member of the Royal Society of London. He was made honorary professor of physics in the University of Berlin in 1900. He resigned his post at Charlottenburg in 1905. He was elected an honorary member of the Physical Society of London in 1906. He died at Marburg in January of this year.

Kohlrausch was the author of a great number of papers giving the results of experimental investigations in many branches of physics, but the subjects which chiefly occupied him were the methods of measuring magnetic and electrical quantities. Among his contributions to this branch of science we may mention his method for the absolute measurement of the horizontal component of the earth's magnetic field and of the strength of an electric current, by simultaneous observations of the deflection of the needle of a tangent-galvanometer and of a suspended coil where both instruments are traversed by the same current. Another important set of experiments, published in 1874, had for its object the determination of the absolute value of the "Siemens unit" of electrical resistance. The result which Kohlrausch arrived at, though afterwards shown to be appreciably in error, was of considerable importance historically, since it directed attention to the necessity of examining further the result obtained in 1863 and 1864 by Maxwell and his coadjutors for the British Association Committee on Electrical Standards.

In 1871 Kohlrausch introduced a method for measuring the electrical resistance of electrolytes founded upon the employment of alternating currents generated by the revolution of a magnet inside a coil of wire, the relative positions of magnet and coil being like those in an ordinary galvanometer. In this way the disturbing effect due to the polarisation of the electrodes was in a great measure, if not entirely, got rid of, and the results obtained were a great advance in respect of accuracy upon those previously obtained. In later modifications of the method the alternate currents of an induction-coil were used. This investigation formed the starting point of a long series of researches into the conducting power of electrolytic solutions. The examination of a great number of soluble salts in aqueous solutions of different concentrations showed that, although the conductivity decreases with decreasing concentration, the ratio of conductivity to concentration increases, at first nearly uniformly, but approaches a definite limit for each salt when very small concentrations are reached, that is, when the solutions are very dilute. It was further found that, when the proportion of salt in solution was expressed in terms of the equivalent mass of the salt, the limiting (maximum) value of the above ratio varied within comparatively narrow limits for a great number of salts. Another important result of Kohlrausch's experiments was the establishment of a simple relation between the conductivities of dilute solutions and the mobilities, as deduced from Hittorf's measurements, of the ions into which the respective salts may be supposed to be broken up when dissolved.

Kohlrausch rendered an extremely valuable service to the teaching of experimental physics by the publication, in 1870, of his "Leitfaden der praktischen Physik." This was the first, and, in the writer's opinion, the best of numerous works of the same kind that have since appeared in various countries, designed to guide students of physics in a systematic course of practical work in the physical laboratory. The high appreciation it has met with is shown by the number of editions that have been called for—it reached the eighth in 1896; it was translated into English by Messrs. T. H. Waller and H. R. Procter soon after its first appearance, and a second English edition was published in 1883.

G. C. F.

SIR CHARLES TODD, K.C.M.G., F.R.S.

Few men have lived a fuller life or given more freely of their best than Sir Charles Todd, whose death we deeply regret to record. It is only about three years ago that he retired from active service, but he was then above eighty years of age and his career had been unusually long. His scientific life dates back to 1841, when he entered the Royal Observatory, Greenwich. The instruments, as those who used them, have passed away, and he must have been the last survivor of the little band who worked with the old meridian transit and circle. There he acquired a training in scientific methods which he was destined to turn to such useful account in promoting the interests of a new colony. In South Australia he found his work, and there his memory will be treasured. For it was his fortune to organise two departments, the Post Office and the Meteorological Service, which have contributed in no small degree to the growth of that thriving settlement.

It is not given to many to see their exertions and plans so speedily and completely successful as did Sir Charles Todd, or to fill simultaneously the three important positions of Postmaster-General, Superintendent of Telegraphs, and Government Astronomer. But it will be admitted that he filled this trinity of offices with credit to himself and to the advantage of others. The Post Office was practically his own organisation, which, continually growing with the requirements of the Colony, proved itself equal to the increasing demands. It was in connection with the establishment of the Telegraph Service, and its growing needs, that he made that remarkable ride of 2000 miles across the arid interior of the continent of Australia, from Adelaide to Port Darwen. The energy and intrepidity of the man were well illustrated by this memorable venture. No wonder that he loved to tell of that day, when he sat on the ground near Mount Stewart, amid uncomfortable surroundings, but forgot all in the sense of successful achievement, when, with a little pocket relay, he connected the wires and held communication with the extreme north and south of the island.

As Government Astronomer, it will be remembered that Sir Charles Todd took part in organising the expeditions for the observation of the transit of Venus, that he kept the 8-inch refractor steadily at work, and did what lay in his power to maintain an interest in astronomy. Still greater was the service he rendered in promoting a meteorological and climatological servey—so necessary in a new country, where the climatic conditions are of vital importance to the incoming settler. For something like forty years he maintained the meteorological service, and has left to his successor a complete and well-equipped organisation.

His talents were admirably fitted for the field in which they found scope. He knew how to inspire others with the tireless energy that carried him through so many difficulties; his geniality secured him many friends and willing workers that enabled him to accomplish so much; his life and history are written in the progress of the colony during the last fifty years. Amid the regrets of those among whom he laboured so well and so long, he will be remembered as one whose services gained the approval of his sovereign and the cordial appreciation of his scientific colleagues, and especially as a typical specimen of that class which, great in resolve as in achievement, has given strength and impulse to our Colonial Empire.

NOTES.

At the meeting of the Paris Academy of Sciences on January 24 Lord Rayleigh was elected a foreign associate member in succession to the late Prof. Simon Newcomb. Lord Rayleigh was elected a correspondant of the academy in 1890.

M. Emmanuel de Margerie has been elected president for 1910 of the Paris Geographical Society, and M. H. Deslandres and Colonel Bourgeois vice-presidents.

During his recent visit to St. Petersburg, Sir Ernest Shackleton was presented with the Constantine gold medal of the Russian Geographical Society.

The Lettsomian lectures on "The Cerebellum and its Affections" will be delivered by Dr. J. S. Risien Russell at the Medical Society of London on February 7 and 21 and March 7.

At the close of a public lecture by Dr. Sven Hedin in Rome on January 30, the King of Italy handed to him the large gold medal which has been conferred upon him by the Italian Geographical Society.

PROF. J. ARTHUR THOMSON has been elected president of the Royal Microscopical Society for the ensuing year.

WE regret to see the announcement of the death, on January 28, at seventy years of age, of Prof. F. Purser, professor of natural philosophy in the University of Dublin and the author of several notable works on Bessel's functions.

THE following officers have been elected for 1910 by the French Physical Society:—*President*, M. L. E. Bertin; *vice-president*, M. Lucien Poincaré; *general secretary*, M. H. Abraham; and *assistant secretary*, M. Jean Becquerel.

THE *Times* states that the Belgian expedition which will leave shortly for the Congo to make investigations in connection with sleeping sickness will be in charge of Dr. Rhodain, professor of bacteriology at the University of Louvain. Work will be begun in the northern part of the Katanga district.

THE president of the Royal College of Physicians has appointed Dr. H. B. Donkin to be the next Harveian orator, and Dr. G. N. Pitt to deliver the Bradshaw lecture. The Milroy lectures are to be delivered by Mr. A. G. R. Foulerton, on February 17, 22, and 24; the Goulstonian lectures by Dr. J. S. Bolton, on March 1, 3, and 8; and the Lumleian lectures by Prof. W. Osler, F.R.S., on March 10, 15, and 17.

WITH the object of giving still greater publicity to the advantages of intensive cultivation an exhibition of "French Gardening" is to be held at the Royal Botanical Society's Gardens at Regent's Park. Active preparations are now in progress for exhibiting and demonstrating every aspect of the close and scientific cultivation of the soil. The exhibition will take place in July, though the exact date is not yet definitely settled.

WE learn from the *Revue générale des Sciences* of January 15 that the French Guild of Jewellers is desirous of having the artificial "rubies" branded as *imitations*, like paste copies. Dr. Olivier, the editor of our contemporary, protests strongly against such action being taken by the Minister of Commerce, seeing that in composition and properties the natural and artificial materials are identical.

THE death is announced of Dr. J. Volhard, professor of chemistry in the University of Halle, at seventy-five years of age. For several years Dr. Volhard acted as Liebig's assistant, and ultimately was entrusted by him with the delivery of the course of lectures on organic chemistry which he regularly gave during the summer semester. His biography of Liebig, published last year, is a valuable and complete record of the life and work of that great chemist.

ON Tuesday next, February 8, Prof. F. W. Mott will begin a course of six lectures at the Royal Institution on "The Emotions and their Expression," and on Saturday, February 12, Sir J. J. Thomson will commence a course of six lectures on "Electric Waves and the Electromagnetic Theory of Light." The Friday evening discourse on February 11 will be delivered by Mr. C. E. S. Phillips, on "Electrical and other Properties of Sand," and on February 18 by Prof. H. H. Turner, on "Halley's Comet."

WE have received a letter signed by Lieut.-Colonel H. W. L. Hime, Sir G. Greenhill, and Mr. Oscar Guttmann, pointing out that at present there is no memorial of the foremost man of science of the thirteenth century, Roger Bacon, who foreshadowed many of the discoveries of modern science, and is known universally as the inventor of gunpowder. Contributions (however small) towards the erection of a memorial, in a suitable place, of this great Englishman may be sent to Mr. Oscar Guttmann, 60 Mark Lane, E.C.

THE executive committee of the National Physical Laboratory, on the nomination of the advisory committee for the national experimental tank, has appointed Mr. G. S. Baker to the post of superintendent of the tank, the funds for which have been provided by the generosity of Mr. A. F. Yarrow. After a distinguished career at the Royal Naval College, Greenwich, Mr. Baker was in November, 1900, appointed an assistant constructor in the Royal Corps of Naval Constructors. He served four years as assistant to Mr. R. E. Froude, F.R.S., at the Admiralty Experiment Works, and two and a half years as professional secretary to the Director of Naval Construction, and has also had experience in the general design work of the Admiralty Office. Thus he goes to the laboratory with distinguished qualifications, and on the strong recommendation of those who have the best grounds for estimating the value of his previous work.

THE permanent committee of the International Congress of Photography is arranging to hold the fifth International Congress in Brussels early next August, or about that time. The primary object of these congresses is to reduce, as far as possible, the confusing and often inconvenient variations that occur in nomenclature, definitions, standards, &c. Promises of support have been received for the coming congress from all parts of the world, and arrangements are being made for the presentation of reports by specialists on recent progress and the present state of knowledge in many of the branches of photographic work. It is hoped that England will take a full share in the congress. A complete programme will be issued as soon as possible. The membership subscription is ten francs or eight shillings, which entitles the member to a copy of the report of the proceedings. Inquiries may be addressed to either of the honorary general secretaries, M. Ch. Puttemans, 1 Palais du Midi, Brussels, or M. L.-P. Clerc, 52 Boulevard Saint Jacques, Paris XIV.; but for the convenience of English members inquiries and subscriptions may be sent to Mr. Chapman Jones, 11 Eaton Rise, Ealing, London, W.

BY the courtesy of the director of the Meteorological Office, the advisory committee for aëronautics is able to announce that a selection of current autographic records of wind velocity from the twenty-three anemograph stations in connection with the office, and other meteorological documents of interest to aëronauts, will be available for inspection at the Meteorological Office daily from 10 a.m. to 4 p.m. (Saturdays, 1 p.m.). The structure of wind and the changes to which it is liable are of great practical importance in aëronautical work. The association of changes in velocity with changes in direction, which are sometimes quite sudden, make aëronautical work especially difficult. There is sufficient information now available to indicate the conditions in which such changes may be expected. The anemographic records are selected to show good examples of the different kinds of wind structure recorded at the anemograph stations in these islands and to illustrate the changes that take place. The phenomena on any selected occasion can be compared with records from barographs or other self-recording instruments, or with the conditions indicated on the daily charts. The exhibits also include the summaries, which are not published, of the wind tabulations for all the anemometers in connection with the office from 1906 to 1909 inclusive. There is, besides, a series of diagrams representing the variation of wind velocity with height for all the kite ascents reported to the office in 1908 and 1909. These diagrams show a remarkable approximation, on many occasions, to direct proportionality between height above sea-level and the wind velocity in the upper air, irrespective of the height of the station at which the observation is made, and suggest a working practical rule for computing the increase of wind aloft. Opportunity is also afforded for considering the computation of gradient wind which must form the basis of any satisfactory method of dealing with wind measurements.

THE Paris floods have fortunately passed their maximum height, and are now generally subsiding. The information to hand having a bearing on the direct cause of the flood is exceedingly meagre, and until the detailed report of the Service hydrométrique is available little can be said. The data collected by this service is very complete, and extends over a period of fifty years. A series of low barometric systems passed over the northern portion of the Mediterranean and the south of France after January 19, and these occasioned exceptionally heavy rains in the catchment basin of the river and its tributaries. In Paris the aggregate rainfall from January 17 to January 25 was 2·08 inches, but this is quite inadequate to occasion the tremendous rise of the Seine which occurred; on no day did the rainfall amount to 0·5 inch. The rains were heavier near the source of the river, and in parts of France and Switzerland the rainfall for the two days January 18–19 amounted to fully 3 inches. According to the *Bulletin International* of the Central Meteorological Office of France, a swelling of the Seine was forecasted for January 20, but so late as January 20 the flood was not expected to exceed about 13 feet on January 22, and on January 21 this estimate was increased to 16 feet for January 23. On this date the estimate was further increased to 22 feet for January 24, and on January 25 the estimate for the increase was to 25 feet on January 26. At 8 a.m. on this date the actual flood reached 24·6 feet at Pont d'Austerlitz, 24 feet at Pont de la Tournelle, and 27 feet at Pont Royal, whilst a further slight increase was anticipated. The flood is said to have attained its maximum height on January 27–28, when it is reported as having reached 30 feet at Pont Royal. This is apparently higher than any previous record, exceeding that of 1764.

IT is with regret that we announce the death, in his sixtieth year, of Prof. W. Hillhouse, who held the chair of botany and vegetable physiology in Mason College and the University of Birmingham from 1882, when the chair was founded, until last year, when he was compelled by ill health to resign his appointment. Prof. Hillhouse was born at Bedford in 1850, and some of the earliest of his botanical work was in connection with the flora of his native county. He became a scholar of Trinity College, Cambridge, and afterwards a lecturer in that University. He was also keeper of the University herbarium. His life at Cambridge was marked by the birth of the *Cambridge Review*, of which he was one of the founders, and the editing of which he shared with Prof. Arnold and Vice-Principal Dale. He was widely known in the Birmingham district for his interest in educational matters, and in particular his efforts were directed to the establishment of a university extension movement in connection with Birmingham. He was a most energetic worker as honorary director of the Edgbaston Botanical Gardens, and was chairman of the council of the Midland Reafforesting Association. He was for a number of years on the Leicestershire Education Committee, and on retiring in 1909 received a very warm tribute for the services he had rendered in promoting the higher education of the county. One of his latest works on behalf of the University was the direction of the preliminary laying out of the ornamental grounds surrounding the new buildings at Edgbaston. His death will be sincerely regretted by his colleagues and by many of his old students, by whom his genial and kindly personality was much appreciated.

THE Victoria Museum of Launceston, Tasmania, is setting an example to other institutions of a like nature in arranging for the preparation of a series of dissected skeletons of native birds preserved in formalin. Of one of these a descriptive account has been published in the shape of a pamphlet, by Mr. H. H. Scott, the curator, under the title of "A Memoir on the Wedge-tailed Eagle, *Uroaëtus audax*; a Study in Avian Osteology."

ACCORDING to vol. ii. of the Journal of the Ipswich and District Field Club, the local excursions have been well attended during the past season, and have attracted a large amount of interest. Specially noteworthy is the discovery of a new Pleistocene bone-bed in a railway-cutting near the city. In connection with another "find" of mammalian remains may be noticed a repetition of the common error of giving *Cervus elephas* as the name of the red deer. The issue concludes with a reprint of a paper, by Dr. Bather, on crinoid remains from the Red Crag.

THE hairy-nosed wombat, *Phascolomys latifrons*, has hitherto been regarded as peculiar to South Australia. It appears, however, that in the Melbourne Museum are preserved four specimens of this species obtained from a lonely part of New South Wales in or near Denison country so long ago as the year 1884. Whether the species still survives there is unknown, but the donor of the specimens stated that it never occurred in any other part of the colony. These New South Wales hairy-nosed wombats are stated to differ from their relatives in the south in the characters of the nose, while the skull appeared to be shorter and rounder. If these differences are well established, the New South Wales form apparently indicates a distinct species.

IN an article on the menageries of the ancients and the Middle Ages and their influence on modern zoology, published in the January number of *La Revue des Idées*, Mr. Gustave Loisel directs attention to the circumstance that in ancient times Indians, Persians, Chaldeans, and Assyrians appear to have completely tamed the larger felines, carrying out this taming process to a considerably greater extent than is accomplished in the case of the hunting-leopard by the natives of modern India. They tamed the lion, for instance, to such a degree that it could be led in a halter and employed in the chase of deer, wild bulls, boars, and asses. It is also considered that the Chinese were the first to domesticate house-cats, and likewise to train cormorants for fishing.

IN an article on Miocene trees, published in the January number of the *American Naturalist*, Prof. T. D. A. Cockerell points out the remarkable resemblance between the fossil trees of the Florissant beds of Colorado and those of Œningen, in Baden. Out of six species selected from each locality, two are common to both sets of strata, while four are representative of each other. Nine other Florissant trees are quoted as being represented by allied forms at the present day, although in no instance is there specific identity, and it is noteworthy that some of the Florissant generic types are now restricted to Asia. Regarding the Œningen beds as of Upper Miocene age, the author considers that the Florissant deposits should be assigned to the same epoch.

To the January number of the *Zoologist* Prof. McIntosh contributes an article on the red or precious coral, in which he traces the evolution of our knowledge of this product from ancient times. Red coral was well known to the Romans, and about the beginning of the Christian era was exported in such quantities to India that it was difficult to obtain in the countries where it was produced. After describing the nature of the organism, and then giving a sketch of the mode of fishing, Prof. McIntosh states that the great bulk of the coral is sold at Messina, Naples, Genoa, Leghorn, and Marseilles, while the product of the Algerian fishery goes to Pisa and Trapani. About 160 tons of coral are brought yearly into Italy, the articles made from which are valued at nearly 500,000*l*. The total annual value of rough coral has been estimated at 2,000,000*l*., while after manufacture the value is stated to reach no less than 10,000,000*l*. The finest quality is of a delicate pinkish or flesh-like colour, uniform in tint throughout, and occurring in large pieces. Inferior samples are sold at 2*l*. per ounce, and small fragments, used for children's necklaces, at 5*s*. an ounce. Even worm-eaten coral has a value in the East, as the natives of certain districts believe that gods dwell in the holes.

DR. VICTOR WIDAKOWICH contributes an important memoir on the inversion of the germ-layers ("Entypie") in mammals to the *Zeitschrift für wissenschaftliche Zoologie* (vol. xciv., part ii.). The memoir is very beautifully illustrated, and the drawings of models of various stages in the early development of the rat should be extremely useful to students of this difficult subject.

IN the *Zeitschrift für wissenschaftliche Zoologie* (vol. xciv., part i.), Prof. B. Bachmetjew makes a very ingenious application of biometrical methods to the solution of the difficult problem of parthenogenesis and sex-determination in bees. From an elaborate statistical study of the variation in the number of hooks on the front margins of the hind wings, he finds that the resulting curves show either one or two maxima of frequency. He maintains that fertilisation of the eggs determines two maxima and parthenogenesis one. Thus queens always show two maxima of frequency in each hind wing; they are produced from fertilised eggs. Drones produced by workers show only a single maximum; they are produced from unfertilised eggs. With regard to sex-determination in bees, he adopts the preformation theory of Schultze and Lenhossék, but with the addition that drones may develop from unfertilised "female" eggs, and that the fertilisation of "male" eggs does not prevent the development from them of drones. He finds that one-year-old queens produce drones from unfertilised eggs—this appears to be the normal method. Queens of two or three years produce drones partly from unfertilised and partly from fertilised eggs, because, with advancing age, the closing mechanism of the seminal reservoir no longer works properly, and some of the drone eggs get fertilised, as it were, accidentally. Queens of four years and older produce drones from unfertilised eggs only, because all the spermatozoa have been used up. Several polymorphic forms of drones occur in the same colony, the form depending upon whether they are produced from fertilised or unfertilised eggs. Workers are produced only from fertilised eggs.

THE correct botanical nomenclature of the plants yielding commercial cottons has provided much subject for controversy. A recent paper communicated by Mr. F. Fletcher to the *Cairo Scientific Journal* (November, 1909) discusses the botany and origin of American upland cotton. Evidence is adduced for the opinion that this well-known plant does not show the characters indicated by Miller's type of the species *hirsutum*, but conforms to the description and drawing issued by Tenore for *Gossypium siamense*. The author states that *Gossypium religiosum* of Linnæus also refers to the upland plant, but gives reasons for disregarding this specific name in favour of the former.

THE twentieth number of Notes from the Royal Botanic Garden, Edinburgh, completing the fourth volume, contains several short papers on abnormal developments in plants. Mr. A. J. Gray records an irregular condition in the sporocarp of *Salvinia natans*, where megasporangia were discovered in a microsporangial fruit, and Miss B. Chandler describes cases of anomalous branching at the end of aërial roots of *Tibouchina moricandiana* consequent upon the arrest in growth of the apical meristem. There is also an article, contributed by Mr. F. Darwin, referring to John Hope, a professor of botany in Edinburgh in 1780, and directing attention to certain of his drawings which indicate a knowledge of the light sensibilities of plants much in advance of the published references on the subject.

AN important paper by Dr. M. Greshoff, collating a large number of phytochemical investigations carried out by him in Kew Gardens, is published in the tenth and final index number of the *Kew Bulletin* for 1909, where there also appears the announcement of the author's sudden death. Dr. Greshoff had previously studied the occurrence of alkaloids and hydrocyanic acid in plants, and instituted the investigations here described with the object of discovering new plants of medicinal value, and of testing the presence of chemical constituents as a character of systematic value. The majority of the notes refer to the occurrence of saponin or hydrocyanic acid. Among the plants yielding saponin reactions are several genera of the Leguminosæ, notably Astragalus, which provides some of the American poisonous loco-weeds, and Acacia, of which several species furnish fish poisons; also four genera of the Caprifoliaceæ, three of the Polemoniaceæ and Phytolacca are included. The cyanogenetic list contains, among others, several genera of the Compositæ, Oxytropis, Drosera, Dionæa, Cystopteris, and Davallia.

THE wine industry of South Africa is discussed in a recent number of the *Agricultural Journal of the Cape of Good Hope*. Vines were introduced by the Huguenots, and found congenial soil and climate; the industry has remained in some districts, but is practically stationary, only 6,000,000 gallons of wines and 1,500,000 gallons of brandy being produced. It is urged that these figures are capable of very material improvement. In 1874 Algerian production was no more than that of South Africa, but is now, as the result of careful development, more than 130,000,000 gallons. Cape Colony, it is urged, could produce the light wines of France and Germany and the heavier wines of Spain and Portugal, and there seems to be no insuperable difficulty in the way of creating a flourishing industry.

THE last series of excavations at the amphitheatre known as Maumbury Rings, near Dorchester, has been conducted under the supervision of Mr. St. George Gray, of Taunton Castle, who asks for further support in this undertaking. One remarkable discovery has been made, that of the *cavea* or den in which the animals were housed in readiness for the performances. Here the débris was found to contain coins of the Emperors Constantine the Great and Hadrian, which indicate the approximate date at which games were conducted by the Romans in this amphitheatre.

Dr. R. B. Bean, of the Anatomical Laboratory, Manila, publishes an account of a new cephalograph, an instrument intended to reproduce the outlines of the human head and face, which he has recently invented. It is based on the cranial instruments of Prof. Rudolph Martin, and is an adaptation of the pantograph. He also issues a further instalment of his examination of the Filipino types in the town of Taytay, which corroborates the conclusion at which he had previously arrived, that the population of the archipelago may be resolved into three types —Iberian, Australoid, and Primitive.

A lengthy but interesting study of memorising various materials by a new method forms the subject of a monograph by Prof. E. A. McC. Gamble, separately published by the *Psychological Review*. In this method a series of colours, odours, or syllables (all three materials are used in different experiments), is repeatedly presented to the subject, who manipulates the members of the series after each presentation and attempts to arrange them in their original order. The repetitions of presentation of the series are continued until successful reconstruction of the order is attained. Miss Gamble terms this method the "reconstruction method," and compares the results with those given by previous methods of experiment in memory. She finds that a relatively small number of repetitions is required for successful reconstruction, even at the outset of the experiments and apart from the well-marked improvement-effects of subsequent practice. Compared with the "learning method," in the reconstruction method the increase of difficulty with increasing length of the series is remarkably small. Again, in contrast to the "learning method," in Miss Gamble's method there is no sharp limit to the length of the series which is reproducible in correct order after a single presentation, and the subject remembers fully as many sequences and rather more positions in longer as compared with shorter series.

The Canadian Department of Mines has issued in advance, from its annual report on mineral production, the chapters by Mr. J. McLeish dealing with chromite and asbestos mining in 1907–8. Canada supplies almost the whole of the world's asbestos, and the Canadian output has increased steadily from 27,414 metric tons in 1902 to 60,372 metric tons, of a value of 190,980 dollars, in 1908. The chief mines are in the eastern townships of the Province of Quebec, especially around Thetford. The Canadian output of chromite in 1908 was 7225 short tons (6554 metric tons), a slight increase over that for the previous year, but less than the record in 1906 of 9033 short tons. New Caledonia remains by far the largest producer of chromite; Turkey is second, and Canada has fallen to the fourth place owing to the rapid development of chromite mining in Rhodesia.

Dr. V. Conrad has recently investigated the annual and diurnal variations in frequency of 2497 earthquakes which occurred in the Austrian Alps and neighbouring districts from 1897 to 1907 (*Mitt. der Erdbeben-Kom. der K. Akad. der Wissen. in Wien*, No. 36). The annual variation is well marked, with its maximum in March and minimum in June, the amplitude being 65 per cent. of the mean monthly number of earthquakes. The diurnal variation is also strongly pronounced, the maximum occurring at 2 a.m. and the minimum from 8 a.m. to 4 p.m. Treating the hourly numbers of shocks with the aid of harmonic analysis, the diurnal period is found to have a maximum at 0¾ a.m., and an amplitude which is 87 per cent. of the average hourly number of shocks. In all probability this daily change in frequency is due to the varying conditions under which the earthquakes are observed.

The *U.S. Monthly Weather Review* for May last (which we have recently received) contains part ii. of Prof. C. F. Marvin's article on "Methods and Apparatus for the Study of Evaporation" (see Nature, November 25, 1909). In this part the author describes the various instruments devised for the experiments upon evaporation of water from lakes and reservoirs undertaken by the Weather Bureau. The different kinds of apparatus, which were designed more especially for evaporation from pans, are clearly illustrated and their use fully explained. Among them is a self-registering gauge invented by Prof. Marvin which records, side by side on the same sheet, rainfall, wind, and evaporation, and seems to meet in a satisfactory manner most of the conditions required of such an instrument; the traces are legible, and the apparatus is said to be portable and easily installed.

The January number of the *Illuminating Engineer* of New York contains a well-illustrated article on the electric lighting of the White House, Washington, a dwelling which it characterises as "decidedly unpretentious and plain" in comparison with many mansions of to-day. The imitation candle supporting a miniature incandescent lamp is the unit on which the lighting system is based. In general, they are grouped and supported in an artistic manner, but in one conspicuous case the supports are much too massive.

The United States Coast and Geodetic Survey has recently published an appendix to the report of 1908 which deals with the magnetic observations made on land and by the four vessels engaged in work at sea during the year ending June, 1908. The observations on land are made with a theodolite magnetometer and a dip circle, and those at sea by means of a Lloyd-Creak dip circle checked at intervals by comparison on land with a magnetometer. The whole of the instruments were previously standardised at the Cheltenham Observatory. The present results are summarised in twenty pages of tables. A comparison with previous results shows that the secular increase of westerly deviation on the Atlantic seaboard is about five minutes of arc per annum. Inland the change becomes very small, but rises again to about four minutes per annum increase in the easterly declination at the Pacific seaboard. It may be noted that these secular changes are not quite in agreement with the representation of them as due to a slow drift of the magnetic system of lines to the west.

Under the London Gas Act, 1905, the gas companies were relieved of any obligation to remove sulphur compounds (other than sulphuretted hydrogen), and to replace the standard Argand burner, London Argand No. 1, by another, the London Argand No. 2. The practical effect of this was to enable the gas supplied to be lower in illuminating value by from 1·5 to 2·0 candles. In addition to this, two of the companies were empowered to lower the minimum candle-power from 16 to 14 candles, and in the Gas Light and Coke Company's Act, 1909, the latter company is also permitted to supply 14- instead of 16-candle gas. The 1905 Act also empowered the controlling authority to make tests of the calorific power, and in the 1909 Act, which has just come into force, a statutory minimum net calorific power of 112·5 calories per cubic foot is enforced. As compared with the state of affairs five years ago, the consumer of gas for power or heating purposes has now to burn about 1200 cubic feet of gas in the place of 1000, costing 3*s.* 2½*d.* as against 3*s.*, plus a meter rental (varying with the consumption), plus the extra cost of repairs caused by the additional sulphur present. The consumer, for lighting purposes, if using throughout an incandescent mantle, is not seriously prejudiced; if, however, he retains the batswing burner, his outlay for the same amount of light has increased in the ratio of about 4/3, plus a meter rental and plus an increased cost of internal decoration due to the condensation on the walls and ceilings of an increased amount of sulphuric acid.

THE *Scientific American* for January 15 shows an illustration of the McClean-Lissack automatic rapid-fire gun, which was tested last year by the Ordnance Department of the United States Army. This gun is designed for attacking balloons, and is mounted on a Packard 3-ton automobile truck. The gun fired 3-lb. shots at the rate of 100 per minute, the range being 3½ miles. With brakes on, the truck did not move on firing, and no shock was perceived by those standing on the truck platform. With brakes released there was a slight movement on the recoil, but no shock. Further tests with this gun are being made at Sandy Hook and Springfield for the army, and at Indian Head for the navy. The same article also illustrates two German automobile guns designed for the same purpose. One of these is mounted on an armoured truck of 60 horsepower, capable of a speed of 45 kilometres per hour. The shell from this gun has a maximum height of trajectory of 3800 metres.

THE ninth report to the alloys research committee was presented by Dr. W. Rosenhain and Mr. F. C. A. H. Lantsberry at the meeting of the Institution of Mechanical Engineers on Friday, January 21. Dr. Rosenhain explained that this report dealt with the properties of some alloys of copper, aluminium, and manganese, and is confined to some of the more interesting alloys likely to be of practical service. The greater part of the work was confined to alloys containing less than 11 per cent. of aluminium, and also less than 11 per cent. of manganese. It is impossible to state adequately and briefly the enormous amount of valuable information resulting from this research—the report occupies 174 pages of the institution's transactions. Specific mention might be made of the great tensile strength exhibited by one of the alloys in the form of a cold-drawn bar, having a yield point of 40·88 tons per square inch and an ultimate stress of 52·08 tons per square inch. This alloy had 9·99 per cent. aluminium, 2·01 per cent. manganese, and 88 per cent. copper. Another alloy shows hardness sufficient to enable it to take a cutting edge that will sharpen a lead pencil. In addition to the mechanical tests and microscopic and freezing-point investigations, corrosion in sea water has been examined. Further and more searching tests on the latter are now proceeding at Portsmouth Harbour, and have also been arranged for in the warmer sea water at Malta Dockyard.

THE January number of the Journal of the Royal Statistical Society begins a new series of the journal, to be issued monthly during the session. It is hoped that the greater rapidity of publication thus secured will be of service, as papers read one month will now be in the hands of fellows, and the public generally, by the middle of the following month instead of sometimes not appearing for three months or more, as is necessarily the case with a quarterly journal. Current notes also form a new section of the journal which it is hoped will increase its general interest.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 4. 5h. Venus in perihelion.
6. 12h. Mercury stationary.
7. 12h. 25m. Uranus in conjunction with the Moon (Uranus 3° 19′ N.).
9. 12h. 36m. Venus in conjunction with the Moon (Venus 13° 34′ N.).
12. 0h. Venus in inferior conjunction with the Sun.
13. 13h. 22m. Saturn in conjunction with the Moon (Saturn 1° 18′ N.).
15. 6h. 12m. Mars in conjunction with the Moon (Mars 3° 1′ N.).
19. 17h. Mercury at greatest elongation west of the Sun.
19. 21h. 33m. Neptune in conjunction with the Moon (Neptune 4° 10′ S.).
20. 3h. Venus at greatest heliocentric latitude north.
,, 17h. 34m. Jupiter in conjunction with the Moon (Jupiter 2° 29′ S.).

MARS.—Readers of these columns should be fairly well acquainted with Prof. Lowell's views concerning the Martian features and their significance, but they will find interesting the comprehensive summary given by Prof. Lowell in No. 13 of *Scientia*, the international science review published at Bologna, and obtainable from Messrs. Williams and Norgate. Therein the author reviews the observations of the melting snow-caps, of the "canals" and oases, which, by virtue of their dependent vegetation, undergo striking changes in conformity with the Martian seasons, and the theoretical considerations which have led him to conclude that Mars is habitable by organisms not essentially different from those with which we are acquainted. That Mars has no water except that contained in its atmosphere and that which forms the snow-caps, Prof. Lowell avers, but he contends that that water is artificially "engineered" in such a way that organic existence is rendered possible.

CAROLINE HERSCHEL AND HER COMET SEEKER.—At the present moment, with the subject of comets so much to the fore, an article which appears in the January number of *Himmel und Erde* is of especial interest. The writer gives many details of Caroline Herschel's strenuous life and describes her labours with the comet seeker. A facsimile reproduction of a letter, dated August 5, 1831, from her to Director Hausmann, tells how the comet seeker was made and how she wished it to be used after she had finished with it. The instrument was made of odds and ends by her brother "between breakfast and dinner." "The tube had once been used as a Newtonian finder to the 20-foot reflector. The circular board once served for a fly-wheel in some experiment; and for the pole, I was sent to the scullery to find a mopstic. The rest was sawed and chopped in the shapes as they were wanted—as for plaining we could do without, there was no time for niceties." Yet, she adds, it stood for forty-seven years without wanting a single repair, travelling all over the house and garden, at Slough, many a night; and with it she discovered five of the eight comets credited to her name.

EDDY FORMATION IN THE WAKE OF PROJECTING OBSTACLES.

CONSIDER a stream bounded by and moving parallel to the plane OX, with velocity U, and containing a stationary vortex at A (a, b), or, what is the same thing, an unbounded fluid containing a stationary vortex-pair at A, B (Fig. 1). With the notation $w=\phi+\iota\psi$, $z=x+\iota y$, ϕ=velocity potential, ψ=stream function, the potential function is given, for this case, by

$$w=\mathrm{U}\left(z+2ib\log\frac{z-a-ib}{z-a+ib}\right).$$

Inside a certain surface OQP, the stream lines are closed curves and the motion is cyclic; outside, the fluid streams past the surface as if it were a solid obstacle, as is well known (*e.g.* Lanchester, "Aerodynamics," § 80). If the bounding surface meets the plane boundary OP at O, and O is the origin, then $dw/dz=0$ when $z=0$, whence we easily have $a=b\sqrt{3}$ in the above expression.

Now substitute $z=\sqrt{z'}$, and the solution is obtained of a *continuous* motion round the straight edge past O, with a single vortex in the dead water in the wake of the edge (Fig 2).

Making the substitution, we now write

$$w=A\left(\sqrt{z'}+2ib\log\frac{\sqrt{z'}-(\sqrt{3}+i)b}{\sqrt{z'}-(\sqrt{3}-i)b}\right),$$

where A is a constant, and we find that when $z'=0$, $dw/dz'=-A\sqrt{\tfrac{3}{4}}b$.

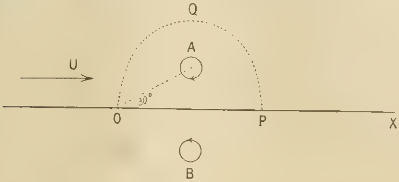


FIG. 1.

The velocity is thus finite where the stream leaves the plate.

With $z'=z^{\frac{3}{2}}$ we get a streaming motion round a rectangular corner with a single vortex in the dead water (Fig. 3), and similarly with $z'=z^n$, where $1<n<2$, we get a streaming motion past a projecting corner with re-entrant angle $n.180°$ (Fig. 4). But here comes the difficulty, *if it is a difficulty*.

Except in the above case of $n=2$, the velocity vanishes at the origin, and, further, the stream line bounding the dead water makes equal angles with the two parts of the fixed boundary; thus, for the right angle of Fig. 3, the boundary of the dead water starts from the origin at an angle of 135° with the two walls, and the dead water projects forward into the stream.

But is it not the fact that when a stream flows through the arches of a bridge, the dead water *does* project into the current, the circulating fluid pushing the stream into the centre and narrowing it? I believe I have seen something of this very kind.

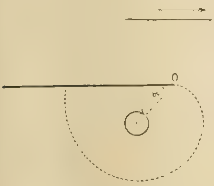


FIG. 2.

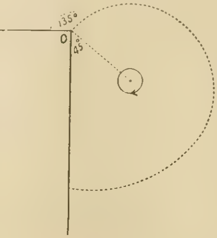


FIG. 3.

As regards the velocity being zero, the same would occur in the hydrodynamical problem representing the motion of two streams meeting at an angle, the velocity vanishing at the projecting angle of the boundary.

If, finally, we apply Schwarz and Christoffel's transformation to our original figure, we can obtain various solutions representing continuous motions past projecting obstacles, maintained by a fixed vortex in the dead water behind them. For example, taking

$$\frac{dz'}{dz}=C\frac{z}{(z-c)^{\frac{1}{2}}(z+c)^{\frac{1}{2}}},$$

or (say),

$$z'=\sqrt{(z^2-c^2)},$$

we get the solution for a broad stream with a pier projecting at right angles to the straight bank, or a current impinging perpendicularly on a lamina, with a couple of vortices situated in the dead water behind it. Moreover, if $c<2a$, the whole of the back of the plate will be in the dead water (Fig. 5), while if $c>2a$ the current will flow round and on to the plate, leaving dead water only near the edges (Fig. 6).

The whole point which I wish to emphasise is that hydrodynamical solutions can be obtained of cases of eddy formation in the wake of a projecting obstacle by taking Fig. 1 and the corresponding formula, and transforming by the usual methods of conformal representation, *transforming the point O of Fig. 1 into the projecting or re-entrant angle.* No other point can be so transformed without making the velocity infinite, except P. We should then have the vortices in front of the obstacle, and this would certainly give a solution of the hydrodynamical equations, but it is difficult to see how vortices would get to the right points, and uncertain whether they would be stable there.

I have seen nothing like these solutions, yet it is hard to imagine that anything so simple can have escaped attention in a well-worn subject like hydrodynamics, especially as the motions bear a strong resemblance to certain observed phenomena. If it should transpire that these problems have been solved before, it seems desirable that attention should be directed to them in view of the importance which such problems have assumed in connection with aërial and other navigation.

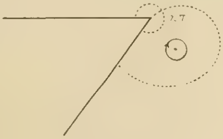


FIG. 4.

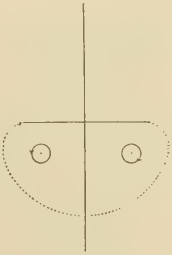


FIG. 5.

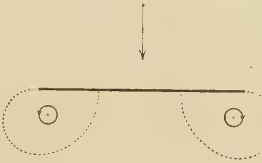


FIG 6.

G. H. BRYAN.

THE NEW COMET (1910a).

IN those places where there has been a clear horizon at sunset during the past week, the new comet has provided a striking spectacle for thousands of observers. The observations made at the established observatories will have to be reduced and discussed, and some time will elapse before they are generally available, so at present we have only the meagre details of telegraphic summaries.

From these we learn that excellent photographs have been obtained at Oxford, Cambridge, Dublin, Stonyhurst, and other observatories, including the Harvard, Yerkes, and Lick institutions. Numerous observers have recorded changes in the appearance of the comet, and it will be interesting to see if these are shown on the photographs.

The elements and ephemeris issued from Kiel are evidently considerably in error; according to Prof. Turner, the error was 3° in declination on January 26, and was increasing 40′ daily. On that day the comet's position was determined at 5.35 p.m. by Dr. Rambaut, at the Radcliffe Observatory, as R.A.=21h. 20m. 40s., dec.=2° 17′ S.; according to the ephemeris, it should have been approximately 21h. 26·9m., 0° 52·5′ N. According to Mr. Crommelin, speaking at the British Astronomical Association, the perihelion distance given in the elements, viz. nearly 4,000,000 miles, is probably much too small. Prof. Kobold has calculated the following elements and ephemeris from observations made on January 18, 20, and 23:—

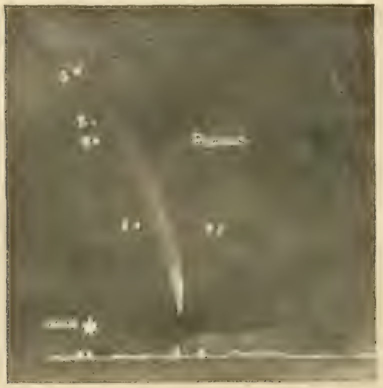
Elements.

$T = 1910$, January 17·07 G.M.T.
$\omega = 311^\circ\ 53'$
$\Omega = 83^\circ\ 59'$
$i = 138^\circ\ 25'$
Perihelion dist. = 0·109

Ephemeris 5 p.m. *G.M.T.*

1910			R.A. h. m.		Decl. ° ′
February 1	...	...	21 38·5	...	+ 3 20
,, 5	...	...	21 47·0	...	+ 5 50
,, 9	...	...	21 53·0	...	+ 7 48
,, 13	...	...	21 59·8	...	+ 9 25
,, 17	...	...	22 5·2	...	+ 10 52

The spectrum of the comet has been observed a number of times at Cambridge, and found to consist of a bright yellow line in a continuous spectrum, thus far confirming the Lick observation. To the *Times* Sir Robert Ball reported this line as being due to sodium or helium, and stated, on January 26, that it was growing fainter. In a subsequent interview Mr. Hinks is reported to have said that Prof. Newall's observations showed that the spectrum of the comet's tail was purely monochromatic, the one line being due to sodium or helium, probably the latter. It will be remembered that Copeland and Lohse observed bright yellow lines in the spectrum of the great comet of 1882, but they were confirmed by Thollon and Gouy in ascribing them to the sodium, D, lines; further, they found them displaced towards the red sufficiently to give a measure of the comet's velocity of recession which agreed fairly well with the velocity determined geometrically. Should the presence of helium in the spectra of comets which have small perihelion distances be established, it might throw more light on Prof. Newall's suggestion that possibly the cyanogen spectrum so frequently observed is produced in the medium through which the comet is travelling; but the observation of cometary spectra is a delicate one, and not until the details of the observations have been thoroughly discussed by those who made them may any semblance of a definite conclusion be arrived at.



View of the New Comet on January 29 (W. E. Rolston).

Prof. Dreyer reports (the *Times*, January 27) that observations made with the 10-inch refractor at Armagh on January 21 and 24 showed a fan-shaped jet on the side of the comet's head turned towards the sun. The matter [illegible] from the fan, and turning back on both sides to form the tail, was distinctly broader south-east of the nucleus than west of it.

Observations at the London observatories have been greatly interfered with by the smoke and haze at the horizon and by clouds. On January 25 the comet was "glimpsed" at Greenwich, and its position was determined the following day.

Successful photographs were obtained on January 28 and 30, and show, in addition to the two main streamers, a much fainter tail which makes a considerable angle with the main tail and gives the comet an appearance similar to that of the great southern comet of 1901.

At the Solar Physics Observatory, South Kensington, Dr. Lockyer saw the comet on Friday evening, January 28, just before 6 p.m., but there was not time to determine its position exactly before clouds again interfered.

Visual observations made at South Harrow on January 29 by Mr. Rolston showed the comet as a magnificent object with a curved tail extending nearly to ξ Pegasi, that is to say, about 20°. The rough sketch reproduced herewith shows the relative position and extension at 6.20 p.m.

Mr. F. C. Constable, of Wick Court, near Bristol, directs attention to a projection extending from the base of the double tail on the side nearer to Venus. In a rough sketch, made at 6.20 p.m. on January 30, he shows this projection as a short, bushy tail inclined some 20° to the axis of the main tail.

Father Cortie states (*Times*, January 29) that on January 26 the comet was seen at Stonyhurst from 5.40 to 7 p.m.; the nucleus was as bright as a first-magnitude star, and the tail could be traced to a distance of 10°. Observed with the 15-inch refractor, the region near the head showed a deep, wide, dark segment running down the tail, recalling to mind the drawings of Donati's comet made by Bond and Pape.

Two photographs taken with the 6-inch Dallmeyer portrait lens show a cloud of particles to the east of the main tail, bounded by a ray making an angle of about 30° with the main axis; presumably this is the projection also observed by Mr. Constable.

On the Stonyhurst photographs the tail can be traced to a distance of 4°, and has the appearance of being a hollow cone, the two bright wings of the tail being the sides of the cone in projection. A glimpse at the spectrum with a small McClean direct-vision spectroscope showed that it was continuous, with a decided brightening in the green, presumably due to a hydrocarbon band; the colour of the comet was decidedly yellowish.

A number of observations are recorded in No. 4385 of the *Astronomische Nachrichten*. M. Gonnessiat, Algiers, suggests that between January 19 and 20 the brightness decreased two magnitudes, and other observers record the rapid decrease. On January 23 Prof. Kobold found the nucleus to be of the third magnitude and the length of the tail to be 15°. From the *Times* (January 31) we learn that, presumably on January 28 or 29, Prof. Nijland, Utrecht, saw a tail 30° long, strongly convex towards the west, and reaching a few degrees to the left from α Pegasi. On Saturday Prof. Turner recorded a faint tail 15° or 20° long. Mdlle. de Robeck, of Inistioge, Kilkenny, reports that the comet was well seen at that place on the four nights succeeding January 22, and provided a fine spectacle just after sunset; she likens it to an egret's plume, which stood out with remarkable clearness against the golden-red background of the sunset sky.

A *Times* correspondent, writing from Malvern, directs attention to a remarkable glare which he saw, on January 30, extending from the concave, or southern, side of the tail well up into the square of Pegasus. This lateral extension through an angle of nearly 80° set with the stars.

THE MESSINA EARTHQUAKE AND THE ACCOMPANYING SEA-WAVES.

A SUMMARY of Dr. M. Baratta's preliminary report on the Messina earthquake has been given recently in NATURE (December 16, 1909, p. 203). Since then two other memoirs have appeared, one a preliminary report by Prof. Omori (Bulletin of the Imperial Earthquake Investigation Committee, vol. iii., No. 2, Tokyo), and the other a detailed account by Prof. G. Platania of the accompanying sea-waves (*Boll. della Soc. Sism. Ital.*, vol. xiii.).

Prof. Omori states that the area of violent motion was elliptical in form, and about 30 km. long from north to south and about 20 km. wide. Judging from the form and position of this area, the origin seems to be situated beneath the Straits of Messina, and the directions of maximum motion at several places radiate from a spot within the Straits between Messina and Reggio, and somewhat nearer the latter town. The sea-waves caused the greatest damage along the Calabrian coast from Pellaro to Lazzaro, where many houses were destroyed by them, and the sandy shore-ground to a maximum breadth of 100 metres was swept away. It is remarkable that the sea-waves were greatest at those places where the shock was not most violent. They appear to have radiated from two centres, which may, however, be portions of a continuous zone of disturbance. Prof. Omori believes that the sea-waves were principally due to the depression of the ground under the portion of sea in question. This latter action, he says, might consist in the vertical settlement through one or two metres of the loose superficial deposits at the bottom of the Straits, such as was known to occur along the shores. The report is illustrated by some interesting maps and diagrams. One of these, here reproduced (Fig. 1), shows the curved band along which lie the areas of violent motion of thirteen great earthquakes in central and southern Italy. These areas being almost distinct, Prof. Omori concludes that great disturbances are not repeated from one and the same centre, that Messina and Reggio are therefore comparatively safe from further harm, while the portions of the seismic band intervening between those mapped are, seismically, the most dangerous in southern Italy.

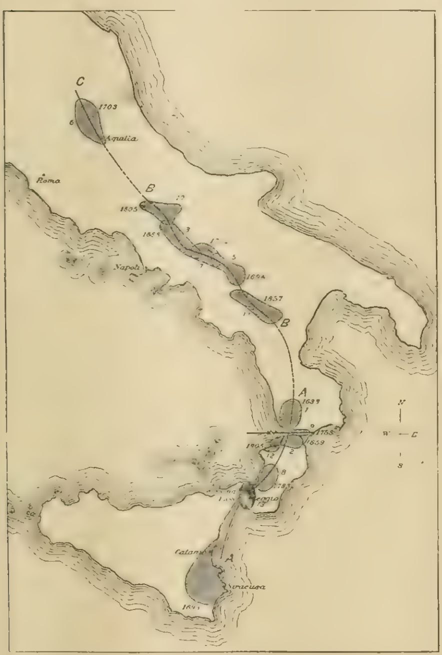


FIG. 1.—Map showing the mutual relations of the great destructive earthquakes in Central and Southern Italy. The shaded area No. 13 is the violent motion district of the Messina-Reggio Earthquake; the other areas, Nos. 1–12, are the similar districts for the previous twelve great earthquakes.

Prof. Platania's report on the seismic sea-waves is one of unusual interest and value. According to Prof. Omori, the maximum height of the waves (of 10·6 metres) was reached on the Calabrian coast between Pellaro and Lazzaro, but for the opposite coast, at S. Alessio, Prof. Platania gives a height of 11·7 metres, or 37 feet. All along the east coast of Sicily the waves were perceptible, though at the northern point (Torre di Faro) they only attained a height of 0·8 metre, and at the southern point (Capo Passero) of 1·5 metres. Along the north coast they were observed as far as Termini, and along the south coast as far as Porto Empedocle. The limits along the Calabrian coast are still unknown. In the Lipari Islands they passed unnoticed, while they were very conspicuous at Malta. At Catania the mareograph was inundated, and the driving clock was stopped by the shock; but good records were given by the mareographs at Malta, Palermo, Mazzara, Cagliari, Ischia, Naples, Civitavecchia, Livorno, and Ravenna. With the exception of Cagliari, the period of the oscillations was approximately the same at each place as that of the seiches due to meteorological causes—a coincidence already noticed by Omori and Honda in other cases. The wave-velocity obtained from the formula $V=\sqrt{(gh)}$ is always much greater than the observed velocity by from 25 to 57 per cent. Taking variations of depth, however, into account, the discrepancies tend to disappear. Of the four submarine cables beneath the Straits from Torre del Faro to Bagnara, only one was broken, and this was close to the shore, and was probably caused by the drifting of a ship's anchor. Two telephone cables were broken by the earthquake, one at about 3 km. from Gallico, and at a depth of 500 metres, the other at about 12 km. east of Vulcano. Interruptions also occurred in the Malta-Zante cable ten and eighteen hours after the shock, and at distances of eighty and fifty-eight miles from Malta.

C. D.

THE MARINE AQUARIUM, MADRAS.

THE Marine Aquarium at Madras, which has recently been thrown open to the public, deserves notice as it is the first institution of its kind in India, if, indeed, it is not the first in the tropics. It owes its inception to Lord Ampthill, who, while Governor of Madras some four years ago, drew up in conjunction with Mr. Edgar Thurston, superintendent of the Madras Museum, the first rough plan of a public aquarium. The building, a low, unpretentious brick edifice, is situated on the seaward side of the famed Madras Marina, less than a hundred yards from the sea. The main entrance leads into a large paved area with a central fresh-water pond and fountain, and on either side five tanks with plate-glass fronts, lit from above, each measuring $7 \times 3 \times 3\frac{1}{2}$ feet. The entire seaward side of the central area is occupied by a large open tank, at present stocked with turtles (*Chelone midas*). On either side of the entrance passage are two rooms designed for committee meetings, for storage of materials, &c., and one of them is at present occupied by the aëration plant.

With the exception of two tanks for fresh-water fish (at present containing species of Megalops, Ophiocephalus, Notopterus, &c.), which are oxygenated by living Vallisneria, the remaining eight contain salt water, which circulates from tank to tank, and in addition are supplied with air from two compression cylinders, forced into each tank through a filter candle. At present the cylinders are filled by hand-pumps, but the use of an oil engine is contemplated. Sea water is conveyed to a covered well in the rear of the aquarium along a pipe filled by hand at the seaward end. From the well it is pumped into filter beds, and from these passes to large elevated cisterns, whence it is distributed to the tanks. The shore water on the Madras coast is so disturbed by the surf that this filtration is unavoidable, though the removal thereby of small organisms is undoubtedly a drawback. The water which has circulated through the aquarium tanks can, if desired, be brought back to the filter beds and used a second time.

The director of the aquarium is the superintendent of the Madras Museum, and he is assisted by a local committee. A small admission fee is charged, and already there are signs of the place becoming very popular, more than 1100 visitors having been admitted on a single day. The magnificent colours of many of the fish, in particular, form a most attractive display. The exhibits include sea-snakes (Enhydrina and species of Distira), and among the fish species of the following:—Ginglymostoma, Stegostoma, Chiloscyllium, Muræna, Arius, Therapon, Serranus, Lutjanus, Myripristis, Trachynotus, Pterois, Caranx, Antennarius, Heniochus, Julis, Teuthis, Balistes, Tetrodon. The invertebrates comprise cuttle-fish, holothurians, hermit-crabs (Clibanarius, &c.), swimming-crabs (Scylla and Neptunus), lobsters (Panulirus), prawns (Penæus), &c. All the specimens have been taken on the Madras coast within a few miles of the aquarium.

INDIAN MUSEUM PUBLICATIONS.

According to the report for 1908–9, the organisation of the Indian Museum has been in need of reform, and the views of the trustees in this respect are shared by the Government of India. The trustees have accordingly "accepted the Government of India's proposals as regards fresh legislation whereby a re-organisation of the museum may be effected. The two main principles that they have had before them in the suggestions they have made to the Government as regards this new legislation have been (1) that each section of the museum should be under proper expert management, and (2) that the heads of the different sections should be *ex officio* trustees themselves. They believe that the new Act which it is proposed to introduce shortly, and of which they have received a draft, will enable them to give effect to these principles.

"The trustees have also to express their gratitude to the Government of India for the support given them in their proposals regarding an increase in the scientific staff and in the pay of the superintendent of the natural history section. They are of the opinion that the alterations sanctioned in these respects will not only enable them to retain the services of their officers in a way that has not proved possible in the past, but will also increase the utility of the museum in many directions. . . . They note with satisfaction the increase, not only in the collections, but also in the scope of the scientific work accomplished by these means; but they are convinced that only a permanent re-organisation of the staff such as has now been rendered possible will enable the museum to maintain and expand its work as a centre of zoological work both purely scientific and directly practical."

No. 3 of the second volume of "Memoirs of the Indian Museum" is devoted to a description, by Dr. R. E. Lloyd, of the deep-sea fish caught by the R.I.M.S. ship *Investigator* during the present century. Colonel Alcock's catalogue of the deep-sea fish taken by the same vessel during last century was published ten years ago, and the present memoir includes notices of such forms as have been named since that date, together with the descriptions of five new genera and species. Four of the new genera appear to be nearly allied to previously known types, but the small, tadpole-like *Liparoides beauchampi* differs from other deep-sea Cyclopteridæ (misprinted Clycopteridæ in the memoir) by the possession of a diphycercal tail and small pelvic fins not fused into a sucker. The memoir concludes with a notice of supposed evidence of mutation in a small pediculate fish of the genus Malthopsis from the Andamans. These fishes were taken from four separate but not very distant stations in the Andamanese Sea, where they appear to form distinct communities; they include five types differing from one another in the relative breadth of the disc and the form and arrangement of the dermal ossicles. These differences can scarcely, however, be regarded as of specific value, while as two or more types occur at each station they obviously do not indicate local races.

The trustees have sanctioned the publication of an annotated list of the Asiatic beetles in the collection of the Indian Museum, under the editorship of the superintendent of the natural history section, of which the first part, dealing with the tiger-beetles (Cicindelinæ), has been issued. The text is in somewhat small type, and it is unfortunate that the specific names are printed in italics similar to those used for the publication-references. Moreover, the references are not free from misprints, as witness *Deutshe* on p. 9, while to others than specialists such references as *Jahrb.* (p. 10) and "*Ent.*" (p. 12) are meaningless.

The third part of vol. iii. of "Records of the Indian Museum" contains a large number of papers dealing mainly with invertebrates, and especially insects. Dr. Annandale has, however, a note on lizards from Travancore, in which reference is made to colour-changes in *Charasia blanfordiana*, a relative of the well-known *Calotes versicolor*. The lizards of this genus appear to take the place in India occupied in the Himalaya, and Asia and Europe generally, by Agama. The colour-changes do not seem always for the purpose of concealment, as the author has seen a specimen temporarily pale in colour basking on a red mud-wall, and a second in full sunshine on a black rock. Other specimens, on the contrary, in similar situations, were more in harmony with their surroundings in the matter of colouring.

MENDELEEFF'S LIFE AND WORK.[1]

To many of the present generation of English chemists the commanding, patriarchal figure of Mendeléeff was quite familiar. Though his several visits to London were often connected with official business of the Russian Government Department of Weights and Measures, of which he was the chief official during the later years of his life, he came several times with more purely scientific objects. In 1889 the occasion of his presence in London was the Faraday lecture, which he had been invited to give to the Chemical Society, but which, owing to a sudden and urgent recall to his home, he was unable to deliver in person. His last appearance in this country was in November, 1905, when the Copley medal was awarded to him by the Royal Society.

The Chemical Society can see his face no more, and all that it can now do is to inscribe high on its roll of honour the name which, more than any other, will be for ever associated with the development of the great generalisation known as the periodic system of the elements.

Dmitri Ivanovitsch Mendeléeff[2] was the fourteenth and youngest child of his parents, Ivan Pavlovitsch and Maria Dmitrievna, *née* Kornileff. His father, a former student of the Chief Pedagogic Institute of St. Petersburg, obtained the appointment of director of the gymnasium at Tobolsk, in Siberia, where he met Maria Dmitrievna, who became his wife. After a few years at Tobolsk he was transferred to school directorships in Russia, first at Tambov and afterwards at Saratov; but in order to satisfy the ardent wish of his wife, he took advantage of an opportunity of exchange, by which he became once more director of the college at Tobolsk, and the family returned to Siberia. Here on January 27, 1834 (O.S.) was born Dmitri Ivanovitsch, the youngest son. Soon after his birth the father became gradually blind from cataract in both eyes, and was obliged to resign, the whole family, including eight children, having to subsist on a small pension of 1000 roubles (about 100*l.* per annum). The mother, Maria Dmitrievna, belonged to the old Russian family Kornileff, settled at Tobolsk. They were the first to establish in Siberia the manufacture of paper and glass. In 1787 the grandfather of Dmitri opened at Tobolsk the first printing press, and from 1789 produced the first newspaper in Siberia, the *Irtysch*. The glass works were situated in the village of Aremziansk, a short distance from Tobolsk.

There can be no doubt the mother was a woman possessed of remarkable vigour of mind, who exercised great influence over her children. Her activity and capacity are further illustrated by the fact that when her husband became blind she revived the business of the glass works, and carried it on until after his death from consumption in 1847.

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[1] The Mendeléeff Memorial Lecture delivered before the Chemical Society on October 21, 1909, by Sir William A. Tilden, F.R.S. Abridged from the Journal of the Society for December, 1909.

[2] For many of the details of Mendeléeff's career and of his home life the writer is indebted to the family chronicle compiled, soon after his death, by his niece, N. J. Gubkina (*née* Kapustina), and published in St. Petersburg, also to pamphlets by A. Archangelsky and P. J Robinowitsch. He also desires to express his thanks to Mr. D. V. Téquier, of St. Petersburg, as well as to several Russian friends, for valuable assistance in translation.

Tobolsk was at that time a place of banishment for many political exiles, the so-called Decembrists, one of whom, Bassargin, married Olga, an elder sister of Dmitri. To these Decembrists the boy owed his first interest in natural science. His mother had always cherished the hope that at least one of her children would devote himself to science, and accordingly, after her husband's death and the destruction of the glass works by fire, and spite of failing health and scanty means, she undertook the long and tedious journey from Tobolsk to Moscow, accompanied by her remaining children, Elizabeth and Dmitri Ivanovitsch, with the object of entering the latter, then nearly fifteen years of age, at the university. Disappointed in this object, owing to official difficulties, she removed in the spring of 1850 to St. Petersburg, where ultimately, with the assistance of the director, Pletnoff, of the Central Pedagogic Institute, a friend of her late husband, she succeeded in securing for her son admission to the physico-mathematical faculty of the institute, together with much-needed pecuniary assistance from the Government.

The debt which Dmitri Ivanovitsch owed to his mother he acknowledged later in the introduction to his work on "Solutions," which he dedicated to her memory.

In the Pedagogic Institute Dmitri Ivanovitsch was thus able to devote himself to the mathematical and physical sciences under the guidance of Profs. Leng and Kupfer in physics, Woskresensky in chemistry, and Ostragradsky in mathematics. Unfortunately, at the end of his course his health failed, and about this time his mother died. Having been ordered to the south, he fortunately obtained an appointment as chief science master at Simferopol, in the Crimea. The southern climate soon alleviated the serious symptoms of lung disorder, and removal being necessary in consequence of the Crimean War, he was able soon afterwards to undertake a post as teacher of mathematics and physics at the gymnasium at Odessa. In 1856 he returned to St. Petersburg, and at the early age of twenty-two was appointed privat-docent in the University, having secured his certificate as master in chemistry.

At this time he appears to have passed rapidly from one subject to another, but he soon found matter for serious and protracted study in the physical properties of liquids, especially in their expansion by heat; and when, in 1859, by permission of the Minister of Public Instruction, Mendeléeff proceeded to study under Regnault in Paris and afterwards in Heidelberg, he devoted himself to this work, communicating his results to Liebig's *Annalen* and the French Academy of Sciences. Returning two years later to St. Petersburg, he secured his doctorate, and was soon afterwards appointed professor of chemistry in the Technological Institute. In 1866 he became professor of general chemistry in the University, Butlerow at the same time occupying the chair of organic chemistry.

As a teacher, Mendeléeff seems to have possessed a special talent for rousing a desire for knowledge, and his lecture-room was often filled with students from all faculties of the University. Many of his former students remember gratefully the influence he exercised over them.

One of Mendeléeff's most remarkable personal features was his flowing abundance of hair. The story goes that, before he was presented to the late Emperor, Alexander III., his Majesty was curious to know whether the professor would have his hair cut. This, however, was not done, and he appeared at Court without passing under the hands of the barber. His habit was to cut his hair once a year, in spring, before the warm weather set in. His eyes, though rather deep-set, were bright blue, and to the end of his life retained their penetrating glance. Tall in stature, though with slightly stooping shoulders, his hands noticeable for their fine form and expressive gestures, the whole figure proclaimed the grand Russian of the province of Tver.

At home, Mendeléeff always wore an easy garment of his own design, something like a Norfolk jacket without a belt, of dark grey cloth. He rarely wore uniform or evening coat, and attached no importance to ribbons and decorations, of which he had many.

As to his views on social and political questions, many people thought him a rigid monarchist, but he said of himself that he was an evolutionist of peaceable type, desiring a new religion, of which the characteristic should be subordination of the individual to the general good. He always viewed with much sympathy what is called the feminine question. At the Office of Weights and Measures he employed several ladies, and about 1870 he gave lectures on chemistry to classes of ladies.

Mendeléeff held decided views on the subject of education, which he set forth in several publications, especially "Remarks on Public Instruction in Russia" (1901). Here he says:—"The fundamental direction of Russian education should be living and real, not based on dead languages, grammatical rules, and dialectical discussions, which, without experimental control, bring self-deceit, illusion, presumption, and selfishness." Believing in the soothing effect of a vital realism in schools, he considered that universal peace and the brotherhood of nations could only be brought about by the operation of this principle. Speaking of the reforms desirable, he says that "for such reforms are required many strong realists; classicists are only fit to be landowners, capitalists, civil servants, men of letters critics, describing and discussing, but helping only indirectly the cause of popular needs. We could live at the present day without a Plato, but a double number of Newtons is required to discover the secrets of nature, and to bring life into harmony with the laws of nature." Mendeléeff was evidently a philosopher of the same type as our own Francis Bacon.

In 1863, when twenty-nine years of age, Mendeléeff married his first wife, *née* Lestshoff, by whom he had one son, Vladimir,[1] and a daughter, Olga; but the marriage proved unhappy, and after living apart for some time there was a divorce. In 1881 he married a young lady artist, Anna Ivanovna Popova, of Cossack origin, and lived first at the University and afterwards in the apartments built for the director at the Bureau of Weights and Measures. Here his younger children were born, Lioubov (Aimée), Ivan (Jean), and the twins, Maria and Vassili (Basile).

In 1890, in consequence of a difference with the administration, Mendeléeff retired from the professorship in the University. During the disturbances among the students in that year, he succeeded in pacifying them by promising to present their petition to the Minister of Education. Instead of thanks for this service, however, the professor received a sharp reprimand from the authorities for not minding his own business. The consequence was that Mendeléeff resigned. Independently of the petition, however, there were probably deeper reasons for his being out of favour with the Ministry, connected with his irreconcilable enmity to the classical system of education already referred to. Of this he had made no secret, and it had already brought him into conflict with the authorities. In 1893, however, he was appointed by M. Witte to the office of director of the Bureau of Weights and Measures, which he retained until his death.

Such are the chief features of a great personality. If it be admitted that stories are told of his occasional irritability of temper, we can well place on the other side of the account the cordial relations always subsisting between the professor and his assistants, the confidence and respect between the master and his servants, the deep affection between the father and his children, which are known to have persisted throughout his life, and which could be illustrated by many anecdotes. These stories merely serve "to give the world assurance of a man."

For us who live on the other side of Europe, separated as we are by race, by language, by national and social customs, and by form of government, it is not easy to understand completely the texture of such a mind, the quality of such genius, and the conditions, social or political, which may have served to encourage or to repress its activity. The Russian language may be eloquent, expressive, versatile, and harmonious, or it may possess any other good quality that may be claimed for it by those to whom it is a mother tongue, but the fact remains that it is a barrier to free intercourse between the Russian people and the world outside the Russian Empire. This alone creates a condition which must influence the development of thought, and must give to Russian science and philosophy a colour of its own. Mendeléeff was, like many educated Russians, a man of very liberal views on such subjects as education, the position of women, on art and science, and probably on national government. We can hardly guess what would be the influence on such a nature of a rigid administrative *régime* which forbids even the discussion of such questions. We in England are almost unable to imagine such a state of things as would be represented by the closing of, say, University College for a year or more, because the question whether the House of Lords ought to be abolished had been debated in the Students' Union. Imagine the professor of chemistry, along with his colleagues, for such a reason deprived of the use of his laboratory by the police, and only allowed to resume his studies when someone down at Scotland Yard thought proper. Such being the experience of most of the Russian universities and technical high schools, it is not surprising that the output of Russian science, notwithstanding the acknowledged genius of the Russian people, appears sometimes comparatively small. The amount of work done by Mendeléeff, both experimental and theoretical, was prodigious, and all the more remarkable considering the cloudy atmosphere under which so much of it was accomplished.[1]

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[1] Died in 1899, aged thirty-four.

In 1882 the Royal Society conferred on Mendeléeff, jointly with Lothar Meyer, the Davy medal. In 1883 the Chemical Society elected him an honorary member, and in 1889 it conferred upon him the highest distinction in its power to award, namely, the Faraday lectureship, with which is associated the Faraday medal. In 1890 he was elected a Foreign Member of the Royal Society, and in 1905 he received the Copley medal. So far as England is concerned, his services to science received full acknowledgment. It is all the more remarkable, therefore, that he never became a member of the Imperial Academy of Sciences of St. Petersburg.

Towards the end of 1906 Mendeléeff's health began to fail. Nevertheless he was able to attend the Minister on the occasion of an official visit in January to the office of Weights and Measures, but he caught cold and, enfeebled as he had been by influenza in the preceding autumn, inflammation of the lungs set in. Retaining consciousness almost to the last, he requested even on the day of his death to be read to from the "Journey to the North Pole," by his favourite author, Jules Verne. He died in the early morning of January 20 (O.S.), 1907, within a few days of his seventy-third birthday. He was buried in the Wolkowo Cemetery beside the graves of his mother and son.

Turning now to a survey of Mendeléeff's work as a man of science, it will be sufficient if we pass lightly over his first essays. Like so many other chemists, he began by handling simple questions of fact, his first paper, dated 1854, when he was twenty years of age, being on the composition of certain specimens of orthite. It was not until 1859 that he settled down to serious examination of the physical properties of liquids, which led him to a long series of experiments on the thermal dilatation of liquids, of which the chief ultimate outcome was the establishment of a simple expression for the expansion of liquids between 0° and the boiling point. This formula is liable to the same kind of modification which has been found necessary in the case of gases. It is, of course, applicable only to an ideal liquid from which all known liquids differ by reason of differences of chemical constitution and consequent differences of density, viscosity, and other properties.

Mendeléeff devoted a large amount of time and of experimental skill to the estimation of the densities of various solutions, especially mixtures of alcohol and water and of sulphuric acid and water, and of aqueous solutions of a large number of salts. In 1889 he embodied the whole in the monograph already referred to. In a paper communicated to the Transactions in 1887 (li., 779), he stated his views in the following words:—"Solutions may be regarded as strictly definite atomic chemical combinations at temperatures higher than their dissociation temperatures. Definite chemical substances may be either formed or decomposed at temperatures which are higher than those at which dissociation commences; the same phenomenon occurs in solutions; at ordinary temperatures they can be either formed or decomposed." These views, however, did not prevent his recognising van 't Hoff's gas theory as applicable to dilute solutions.

In conjunction with some of his students, Mendeléeff also studied minutely the question of the elasticity of gases, and published several papers on the subject (see Royal Society Catalogue), extending over a period of some ten years from 1872.

Another subject to which Mendeléeff gave a good deal of attention was the nature and origin of petroleum. Having already reported in 1866 on the naphtha springs in the Caucasus, in the summer of 1876 he crossed the Atlantic and surveyed the oil fields of Pennsylvania. In the course of these investigations, he was led to form a new theory of the mode of production of these natural deposits. The assumption that the oil is a product of the decomposition of organic remains he rejects on a variety of grounds, which are set forth in a communication to the Russian Chemical Society (Abstract, see *Ber.*, 1877, x., 229). Mendeléeff assumes, as others have done, that the interior of the earth consists largely of carbides of metals, especially iron, and that hydrocarbons result from the penetration of water into contact with these compounds, metallic oxide being formed simultaneously. The hydrocarbons are supposed to be driven in vapour from the lower strata, where temperature is high, to more superficial strata, where they condense and are retained under pressure. In 1886, in consequence of rumours as to the possible exhaustion of the Russian oil fields, he was sent by the Government to Baku to collect information, and in 1889 he made a communication on this subject to Dr. Ludwig Mond, which is printed in the Journal of the Society of Chemical Industry (1889, viii., 753).

The influence of the great generalisation known as the periodic law can best be estimated by reviewing the state of knowledge and opinion before the announcement and acceptance of the principle by the chemical world, and subsequently glancing at the influence which, directly or indirectly, it has produced on scientific thought, not only in regard to the great problems to which it immediately relates, but to the whole range of chemical theory.

The use of the expression "atomic weight" implies the adoption of some form of atomic theory; but forty or more years ago Dalton's atomic theory was by many of the most philosophical chemists and physicists regarded as only a convenient hypothesis, which might be temporarily useful, but could not be accepted as representing physical reality. Since that time, however, a variety of circumstances have contributed to consolidate the Daltonian doctrine. The estimation of the ratios called atomic weights has been the subject of research, attended by more and more elaborate precautions to secure accuracy, from the time of Dalton himself onward through successive generations down to the present day. Though the atomic weights of the majority of the common elements are now known to a high degree of accuracy, the acknowledged errors have been sufficiently great to render abortive various attempts to reduce them to any common scheme of mathematical relationship. As is well known, the most important step toward the systematisation of atomic weights was taken about 1860, mainly on the grounds eloquently and convincingly set forth by Cannizzaro,[1] in consequence of which the arbitrary selection of numbers for atomic weights was superseded by the practical recognition of the law of Avogadro and the application of the law of Dulong and Petit, so that a common standard was established. No general scheme of atomic weights was previously possible, partial and imperfect efforts in this direction being represented by Dœbereiner's triads and the principle of homology made use of by Dumas. Only so soon as numbers representing the atomic weights of calcium, barium, lead, and other metals were corrected and brought into the same category as those of oxygen, sulphur, and carbon was there some chance of determining whether these numbers possessed a common factor or were capable of exhibiting mathematical inter-relations which might be regarded as symbolic of physical relations or even directly dependent upon them. The first step in this direction was taken by J. A. R. Newlands, who, after some preliminary attempts in 1864–5, discovered that when the elements are placed in the order of the numerical value of their atomic weights, corrected as advised by Cannizzaro, the eighth element starting from any point on the list exhibits a revival of the characteristics of the first. This undoubtedly represents the first recognition of the principle of periodicity in the series of atomic weights, but whether discouraged by the cool reception of his "law of octaves" by the chemical world or from imperfect apprehension of the importance of this discovery, Newlands failed to follow up the inquiry. It was not long, however, before the matter was taken up by others, and doubtless the improvements in the estimation of atomic weights, following on the work of Stas, then only recently published, inspired greater confidence in the approximate accuracy of the numbers adopted as atomic weights, and thus encouraged inquiry into their relations. The subject is, indeed, an attractive one, for it involves considerations which lie at the foundations of all our notions respecting the physical constitution of matter, and accordingly we find papers by many chemists dealing with the question of these numerical relations. Odling especially seems to have given much thought to the subject, and, ignoring Newlands's previous attempts, he drew up towards the end of 1864[1] a table containing a list of all the then well-known elements, arranged horizontally in the order of their generally accepted groups, and perpendicularly in the order of their several atomic weights. He concludes an article in Watts's Dictionary a few months later with these words:—"Doubtless some of the arithmetical relations exemplified in the foregoing table are merely accidental, but, taken altogether, they are too numerous and decided not to depend on some *hitherto unrecognised* law." It is important to note the words I have italicised.

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[1] Prof. Walden, at the end of a biographical notice recently published in the *Berichte d. Deut. Chem. Ges.*, April, 1909, gives a list of 262 printed publications by Mendeléeff. These include, not only memoirs on physical and chemical subjects, but books, pamphlets, reports, and newspaper articles relating to exhibitions, to the industries of Russia, to weights and measures, to education, to art, and even to spiritualism.

[1] 1858, and later, Faraday Lecture, 1872.

Such, then, was the state of knowledge about this time. Evidently the way was being prepared, but the prophet had not made his appearance—the seer who could look with the eyes of confidence beyond the clouds of uncertainty which obscured all ordinary vision.

In March, 1869, Mendeléeff communicated to the Russian Chemical Society an enunciation of the principle of periodicity and a statement of some of the consequences of this recognition of the relation of properties to atomic weight throughout the whole range of the known elements, and this statement was accompanied by a table which, while it bears a close resemblance to Odling's table of 1864, was apparently connected in his mind with an idea which became clearer and more decisive in the modifications which he immediately afterwards introduced into the arrangement.

Mendeléeff's First Table of the Elements.

			Ti = 50	Zr = 90	? = 180
			V = 51	Nb = 94	Ta = 182
			Cr = 52	Mo = 96	W = 186
			Mn = 55	Rh = 104·4	Pt = 197·4
			Fe = 56	Ru = 104·4	Ir = 198
			Ni = Co = 59	Pd = 106·6	Os = 199
H = 1			Cu = 63·4	Ag = 108	Hg = 200
	Be = 9·4	Mg = 24	Zn = 65·2	Cd = 112	
	B = 11	Al = 27·4	= 68	U = 116	Au = 197?
	C = 12	Si = [illegible]	= 70	Sn = 118	
	N = 14	P = 31	As = 75	Sb = 122	Bi = 210?
	O = 16	S = 32	Se = 79·4	Te = 128?	
	F = 19	Cl = 35·5	Br = 80	I = 127	
Li = 7	Na = 23	K = 39	Rb = 85·4	Cs = 133	Tl = 204
		Ca = 40	Sr = 87·6	Ba = 137	Pb = 207
		= 45	Ce = 92		
		?Er = 56	La = 94		
		Yt = 60	Di = 95		
		In = 75·6	Th = 118		

From this arrangement, in which the elements are placed in vertical columns, according to increasing atomic weight, so that the horizontal lines contain analogous elements, again according to increasing atomic weight, Mendeléeff deduced the fundamental principle which he expressed as follows:—The elements arranged according to the magnitude of atomic weight show a periodic[2] change of properties.

Previous students of the subject had been, for the most part, struck with the relations obviously subsisting between the members of the several natural families of elements, but had, with few exceptions, failed to perceive that there must be a *general* law binding the whole together. However, Mendeléeff, with that noble sentiment of justice which always animates the truly scientific mind, admits that the idea of a general law had already been foreshadowed by others (Faraday lecture, 1889).

Mendeléeff's table of 1869 was subsequently in 1871 modified so as to assume the form with which we have all been so long familiar, and which is to be found in every modern text-book. Thus it may be claimed for Mendeléeff that he was actually the first, not only to formulate a general law connecting atomic weights with properties, but was the first to indicate its character, and, as himself ("Principles," 1905, ii., p. 28) has pointed out, he was the first "to foretell the *properties of undiscovered* elements, or to alter the accepted atomic weights" in confidence of its validity. The time was, in fact, ripe for the enunciation of this general principle, and, the suggestion once given, the relations embodied in the law could not fail to attract other chemists. Accordingly, in December, 1869, Lothar Meyer, with such knowledge of Mendeléeff's scheme as could be derived from the imperfect German version of his paper of the previous March, proved himself a convinced exponent of the idea by contributing to Liebig's *Annalen* a paper containing a table, substantially identical with that of Mendeléeff, and his famous diagram of atomic volumes, which, more clearly even than the tabular scheme, illustrates the principle of periodicity.

The history of science shows many instances of the same kind. Great generalisations have often resulted from the gradual accumulation of facts which, after remaining for a time isolated or confused, have been found to admit of coordination into a comprehensive scheme, and, this once clearly formulated, many workers are found ready to assist in its development. The case is nearly parallel to the recognition of the operation of natural selection by Darwin and Wallace, or it might be compared to the discovery of oxygen by Priestley and Scheele and the utilisation of this knowledge by Lavoisier. In each case much preparatory work had been done, and a body of knowledge had been gradually accumulated which, when duly marshalled and surveyed by the eye of a master, could scarcely fail to reveal to him the underlying principle. The full consequences, however, would appear only to a few.

I regard it as unnecessary, in the presence of the fellows of the Chemical Society, to review with any detail the multitudinous applications of the scheme of the elements constructed on the basis of the periodic law. These are the commonplaces of modern theoretical chemistry. They are embodied in every text-book of any importance, and are related by every lecturer and teacher as familiar and indisputably recognised consequences of the system. We may therefore pass lightly over the story of the prediction by Mendeléeff of the properties of undiscovered elements, confirmed so remarkably by the discovery of scandium, gallium, and germanium, and related in dramatic language by Mendeléeff himself (Faraday lecture). We may also pass over the applications of the system to the correction of atomic weights, illustrated by the case of beryllium, the recognition of previously unnoticed relations, and the discovery of new elements, notably the companions of argon (Ramsay, Presidential Address to Section B, British Association, 1897, and Proc. Roy. Soc., 1898, lxiii., 437).

It will be more profitable to consider a few of the difficulties which still encumber the application of the law, and which, while limiting our acceptance of it in an unqualified form as applicable to the whole of the elements, tempt the speculative mind to wander in wide fields of conjecture.

Can it be truly said that the elements arranged in the order of their atomic weights show without exception periodic changes of properties? This question has been propounded already, but has never been fully discussed, even by Mendeléeff. An examination of the facts seems, however, to indicate the possibility of some other principle, which, while it does not supersede the periodic scheme, would, if it could be recognised, supplement it.

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[1] Quart. J. Sci., 1864, i, 643; and Watts's Dictionary, vol. iii., 975.

[2] Here an error in the German translation does an injustice to the original, inasmuch as the Russian word for periodic is rendered "stufenweise" (gradual).

From a consideration of the almost unbroken sequence in the atomic weights of the known elements, it seems probable that few additional elements are to be expected, except possibly one following Mo and another following W, save in the region from Bi to Ra. This suggests the remark that, after all, it is not necessary to assume that the materials of which the earth consists should necessarily include a sample of every possible element indicated by such a scheme. Some which are missing from terrestrial matters may perhaps be responsible for phenomena recognisable by the spectroscope in stars or nebulæ far distant in cosmical space. The unexpected, however, often happens, and, remembering the discovery of terrestrial helium, it is permissible to hope that some of the vacant spaces may hereafter be filled by earthly occupants.

There is one important point to be noted here, namely, that if the so-called rare earth metals, praseodymium, neodymium, samarium, gadolinium, terbium, dysprosium, erbium, ytterbium, and others of which the existence is doubtful, do lie in the position indicated, the original statement of the periodic law breaks down at this point.

One result of the recognition of the periodic law is that theories concerning the genesis of the elements have received a stimulus previously unknown. It is, however, interesting to note the attitude of Mendeléeff toward this question, and the small extent to which this attitude appears to have become modified with the lapse of time. When, in 1889, twenty years after the discovery of the law, he composed the Faraday lecture, he seems to have regarded speculation in this direction as a kind of abuse of the periodic system.

Fifteen years later, after the discovery of the argon group of elements, of the phenomena of radio-activity, and of radium, it became necessary to consider the relations of these substances to the periodic scheme. In a remarkable article contributed to the new Russian Encyclopædia, and subsequently printed as Appendix iii. to the "Principles" (English edition, 1905), Mendeléeff gives a new table of the elements, in which places are found, not only for the argon group and radium, but for two hypothetical elements, which are placed before helium and designated x and y.

The y in the table is supposed to be an analogue of helium, and may be identified hereafter with "coronium," which has been recognised in the sun's coronal atmosphere. This gas would have, according to Mendeléeff, a density about 0·2, and therefore a molecular weight about 0·4, or about one-tenth that of helium.

x is the "ether" of the physicist, for which Mendeléeff, disregarding conventional views, supposes a molecular structure. He also assumes that, like the argon group, this element is chemically inert and possesses a very low density and atomic weight, estimated at 0·000,000,000,053.

Chemists and physicists have, however, found it impossible to resist the fascination of this problem, and accordingly there have been many hypotheses as to the origin of the elements and the nature of their connection with one another. These seem to be inseparable from the periodic scheme itself, which at once provokes the inquiry, Why do these numerical relations occur, and what is the meaning of them if they do not point to a common genesis or the operation of some process of evolution?

Hypotheses concerning the evolution of the elements have hitherto been usually based on the assumption that the successive stages of condensation of elemental matter proceeded from a single primary stuff, which by a process analogous to polymerisation among carbon compounds gave rise to atoms of greater and greater mass, which were stable at the prevailing and any lower temperature. The physical cause of the successive condensations is supposed to be a falling temperature. It is, of course, possible to imagine that if to the stuff of which hydrogen atoms consist are added successive portions of matter of the same kind, stable structures may at intervals result which we know as the atoms of the elements helium, lithium, beryllium, boron, carbon, nitrogen, oxygen, and fluorine, provided the idea of internal structure in these atoms is allowed. Otherwise, from the mere accretion of matter upon a central nucleus, there seems no sufficient reason why there should not have been formed an indefinite number of intermediate masses corresponding to an indefinite number of what would be called elements. Further, it is difficult to understand why simple increase of mass should change, say, oxygen into fluorine, while a further addition of the same kind should change negative fluorine into inert neon or positive sodium. The possibility of the condensation of a single "protyl" so as to produce, at successive though unequal stages of cooling, the elements known to the chemist, has been most ably discussed long ago by Sir William Crookes.

This hypothesis, however, was put forward long before the work of Sir J. J. Thomson and his school was given to the world and the electron was accepted as a physical reality. The hypothesis that one elemental stuff may give rise to the whole array of known elements by a process of condensation accompanied by a loss or gain of electrons, the mass of which is approximately one-thousandth of the mass of an atom of hydrogen, forms the subject of a paper by Mr. A. C. G. Egerton in a recent number of our Transactions (1909, xcv., 239). The atomic weights calculated by his formula agree closely with the experimental atomic weights of the first fifteen elements, but the hypothesis gives no explanation of the facts observed in the physical properties of the elements arranged according to the Mendeléeff scheme, their alternation of odd and even valency, the transition from positive on one side of the table to negative on the other, the periodicity of properties shown by the sudden change of character in passing from fluorine to the next element, whether it be neon or sodium.

Another paper by Messrs. A. C. and A. E. Jessup (*Phil. Mag.*, 1908 [vi.], xv., 21) has recently provided a hypothesis of an entirely different character. From a study of the spectra of the nebulæ, these authors have been led to assume the existence of two hitherto unrecognised elements, to which the names protoglucinum and protoboron are assigned. These with hydrogen and helium are supposed to represent *four* initial substances, or protons, which, by condensation directly or indirectly, give rise to all the rest of the elements. The arguments of these authors are ingenious, but rather artificial in view of the fact that the number of groups in the periodic scheme to be provided for is greater than four.

In the Mendeléeff chart of the elements there is nothing more striking than the gathering of the negative elements toward what may be called the N.E., and the segregation of the positive elements toward the S.W., the centre of the intermediate territory being occupied by elements which play a more or less undecided part. I have elsewhere (Presidential Address, 1905, Trans., lxxxvii., 564) directed attention to the fact that carbon, at any rate, is not directly deposited by electrolysis from any of its compounds, with positive hydrogen on the one hand, or negative chlorine on the other. I believe the same is true of silicon, these two elements standing in a middle position between the extremes occupied by lithium and fluorine respectively.

If we assume that atoms are made up of two parts (protyls), positive and negative, in proportions which determine by the preponderance of one or the other whether the element shall exhibit the positive character of a metal like lithium or the negative character of a halogen, we arrive at a hypothesis which recalls the ideas put forward nearly a century ago by Berzelius. His views are familiar to every student of the history of chemistry, but have long been relegated to the lumber-room of worn-out doctrine. The last few years have, however, given us the remarkable experimental investigations of J. J. Thomson already referred to, and the new conceptions concerning the nature of atoms, which revive the fundamental idea that they are made up of two components.[1]

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[1] Carnelley, in 1885 (Brit. Assoc. Reports), brought forward the idea "that the elements are not elements in the strict sense of the term, but are, in fact, compound radicals made up of at least two simple elements, A and B." The element A was supposed to be identical with carbon, while to B was assigned a negative weight, −2, and it was suggested that it might be the ether of space. C. S. Palmer (Proc. Colorado Scient. Soc.) assumed the existence of two sub-elements, to which he gave the names "kalidium" and "oxidium," and his views appear to have a general resemblance to the hypothesis suggested in the text. The original article is abstracted in Venables's "Periodic Law," and is referred to in footnotes in Palmer's translation of Nernst's "Theoretical Chemistry."

Setting out the known elements in the order of the numerical value of their atomic weights, we find that between the first three elements, H=1, He=4, and Li=7, the difference, 3, is greater than would be expected by comparison with the differences noticed between the elements of greater atomic weight which immediately follow them. In order to satisfy the hypothesis just put forward, there appears to be wanting an element which should stand in the same relation to fluorine as hydrogen to lithium. This would have an atomic weight 2·7 approximately. Whether this exists, and whether its existence is indicated by the unappropriated spectral lines of nebulæ or corona, can only be a matter of conjecture. Mendeléeff, in his (1905) latest speculations concerning the possibility of still undiscovered elements, has suggested the existence of a new element of the halogen group with an atomic weight about 3;[1] but, as already sufficiently shown, he accepted no hypothesis which involved any idea of the composite nature of the elements. It would therefore have been foreign to his system to employ this element in any such manner.

The conceptions presented to us in J. J. Thomson's work permit of several supplementary hypotheses, especially the idea that if atoms are really made up of smaller corpuscles these are not thrown together in confusion, but, as he has shown, must be distributed within the mass in a definite order, which is determined by the attraction of the electro-positive shell and the self-repulsion of the negative corpuscles included in it. Once the idea of structure within the atom is admitted, the possibility presents itself of there being for the same mass more than one arrangement corresponding to what is called isomerism in compounds.

I have dwelt at some length on these various hypotheses, because the discussion of the subject to which they relate indicates, in my opinion, one of the consequences of the promulgation and general acceptance of the periodic scheme of the elements. This is, however, not the only result of the recognition of its validity and usefulness by chemists generally. That the elements stand in a definite relation to one another implies that their compounds also fall into their places in an orderly system, and consequently a basis is provided for the complete systematisation of the whole science of chemistry. There is scarcely a treatise on chemistry which does not bear evident witness to this influence; and this is perhaps not the least among the services rendered by this generalisation, for not only is the learner enabled to remember a much larger number of facts than previously, but he is led to perceive a connection between phenomena and processes which was almost entirely wanting so long as practical chemistry consisted mainly of a bundle of recipes. Here it is fitting that we should glance at the famous treatise by Mendeléeff himself, "The Principles of Chemistry," of which we possess three editions in English, the last of which, issued in 1905, is a rendering of the seventh edition (1903) of the original. An eighth Russian edition began to be issued in 1905, but is incomplete. To this remarkable book it is impossible to do justice in a brief notice or to communicate to those who have not read it an adequate impression. Clearly it is a work of genius, but such works are not always the most suitable for beginners, though for the advanced student nothing can be more inspiring. The "Principles" embody in reality two distinct treatises, for the text, which is written in an easy style, open to quite straightforward reading, is accompanied by notes which are often more voluminous and usurp entire pages. Even the preface is attended by these commentaries, which are all interesting as showing the spirit of the writer and the restless activity of his mind.

Little more remains to be said. In the seventeenth century Robert Boyle taught us how to distinguish elements from compounds, and how to give to the word "element" a definite connotation clearly distinguishing it from the elusive and fantastic language of the alchemists. In the eighteenth century Lavoisier showed the true nature of the most familiar of chemical compounds, namely, acids, bases, and salts, and helped to lay the foundation of quantitative chemistry. At the beginning of the nineteenth century Dalton gave to chemistry the atomic theory, of which it is not too much to say that it provided the scaffold by the aid of which the entire fabric of modern theoretical chemistry has been built up. Sixty years later this conception, developed and adorned by the labours of an army of earnest workers, has been shown to us in a brilliant new light thrown over the whole theory by Mendeléeff.

The views of Boyle, of Lavoisier, and of Dalton have been corrected by experience and broadened by extended knowledge, but the fundamental and essential parts of their ideas remain, and their names are immortal. In like manner the expression of the periodic law of the elements as known to the present generation is destined, we may believe, to be absorbed into a more comprehensive scheme by which obscurities and anomalies will be cleared away, the true relations of all the elements to one another revealed, and doubts as to the doctrine of evolution resolved in one sense or the other; but as with the atomic theory itself, there is no reason to doubt that the essential features of the periodic scheme will be clearly distinguished through all time, and in association with it the name of Mendeléeff will be for ever preserved among the fathers or founders of chemistry.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Mr. C. Forster Cooper has been appointed demonstrator of animal morphology by the professor of zoology and comparative anatomy for five years from Christmas, 1909.

Dr. Hobson has been appointed chairman of the examiners for the mathematical tripos, part ii. (new regulations), 1910.

The special board for physics and chemistry has appointed Mr. F. W. Dootson as assessor in chemistry to the examiners for the mechanical sciences tripos in 1910.

The Quick professor of biology commenced on February 2 six lectures on the pathogenic Protozoa, to be given on Wednesdays and Fridays. Attendance is free to members of the University. There will be two lectures on February 23 and 25 on "Recent Progress in the Treatment of Protozoal Diseases." These two lectures will be free to all desiring to attend.

The chairman of the board of anthropological studies gives notice that Mr. Roscoe's lectures on the natives of Uganda will be given on Tuesdays, at 5 p.m., in the archæological museum.

Durham.—The University this term comes under the operation of a new constitution established by an unopposed Act of Parliament last session. Originally the effective control of this University rested with the Dean and Chapter of Durham, who founded it, but gradually, after the incorporation of the Newcastle College of Medicine in 1852 and the establishment of the Durham College of Science, now Armstrong College, in Newcastle, actual power passed into the hands of an academic body, the Senate. This body, showing the anomalies of its growth, lately left much to be desired in representing a balance among the interests involved. Fortunately, the interests were not really competitive, and a solution has been found by consent. The Durham colleges retain their original endowments, and remain constituent colleges on the model of the old universities. A new Senate is established, elected in equal shares from Durham and Newcastle, which assigns the conditions for graduation, while each division is at liberty to propose for the approval of the Senate independent courses for the same degree. Thus the degree of B.A., which has hitherto been reserved to students from the Durham colleges, will now be open to students from Newcastle as soon as an approved course is established, and it is hoped that this will lead to a considerable development of Armstrong College upon the arts side, hitherto much stunted in comparison with its equipment for science. The first Vice-Chancellor, appointed on January 25, is Dr. F. B. Jevons, the well-known principal of Hatfield Hall, in Durham. It is much regretted that Sir Isambard Owen, to whose tact the success of the negotiations is largely due, is removed from participation in the first steps of the new plan by his acceptance of the Vice-Chancellorship of the University of Bristol. It will be seen that the new constitution does not bear directly upon the interests of science, but all scientific men will feel that it is an indirect step of the greatest importance to develop thoroughly the arts faculty of a scientific college, and that the added weight of the two Newcastle colleges in the councils of the University cannot fail to enhance their general prestige.

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[1] It may also, perhaps, be worthy of note that Mr. Egerton's calculations (*loc. cit.*) lead him to postulate an element of nearly this atomic weight, namely, 2·9844, although his paper gives no indication as to its character.

The governors of the South-eastern Agricultural College, Wye, have resolved to extend considerably the college buildings, which are at present inadequate owing to the increasing number of students. The proposed extension, which will be ready for the next session in October, will provide extra rooms for in-college students, and will at the same time increase largely the teaching and research accommodation.

The *Times* correspondent at Ottawa states that, as a first step towards the adoption of a system of technical education in Canada, a Royal Commission is to be appointed to report upon conditions in Great Britain, France, Germany, and the United States. Canada has hitherto done little to give a technical training to her artisans owing to the conflict of opinion between the Federal and provincial Governments in respect to jurisdiction.

It is announced in *Science* that Mr. J. Pierpont Morgan has given 20,000*l.* to Yale University, to establish a chair of Assyriology and Babylonian literature in memory of Mr. W. M. Laffan, late editor of the New York *Sun*. From the same source we learn that the directors of George Washington University have announced that they propose to raise an endowment fund of 400,000*l.* Mr. H. C. Perkins, a member of the board, made an initial subscription of 10,000*l.* toward the fund on condition that the sum be raised.

According to the *Revue scientifique*, in 1909 the teaching staff of fifteen French universities was composed of 366 full professors, 102 lecturers, 148 demonstrators in charge of courses of practical work, and 336 assistants. Of these totals, 173 professors, 29 lecturers, 69 demonstrators, and 174 assistant were engaged in pure science. The university grant authorised by the 1910 Budget amounts to 11,679,553 francs for salaries and so on, and 2,229,827 francs for material requirements. These amounts represent an increase over 1909 of 288,086 francs for salaries and 31,000 francs for materials. The increase for salaries includes the first annual grant of 57,000 francs for improving the emoluments of demonstrators in science and pharmacy and of scientific assistants.

The first number of a monthly magazine to be devoted to the discussion of methods for the improvement of the physical and mental conditions under which the work of schools is done has been issued under the title *School Hygiene*. The review is intended for educational workers and doctors, and is published by the School Hygiene Publication Co., Ltd., 2 Charlotte Street, London, W., at sixpence net monthly. To the present issue Prof. H. Griesbach, president of the first International Congress on School Hygiene; Sir Lauder Brunton, F.R.S., president of the second congress; and Dr. A. Mathieu, president of the forthcoming congress in Paris next August, contribute in German, English, and French, respectively, short essays on cooperation in education. The remaining articles deal in an interesting and informative manner with numerous aspects of the health of school children, and when it is added that among the contributors are the headmaster of Eton and Dr. James Kerr, it will be evident that there is a judicious mixture of practical acquaintance with school conditions and of medical knowledge.

The annual statement has been issued referring to the operation of the Rhodes scholarship scheme. After several years' experience, the University of Oxford seems satisfied with the type of scholar sent to Oxford. There were in residence during the academic year 1908–9 179 Rhodes scholars. Of these, 78 were from the colonies, 90 from the United States, and 11 from Germany. At the end of June 33 completed their course, and in October 31 new scholars came into residence. Five were given permission to suspend their scholarships temporarily, while six ex-scholars remain in residence engaged in teaching, research, or special study for examination. The total number of scholars and ex-scholars at the beginning of the new academic year 1909–10 was 178. Of 83 scholars from the United States who completed their course at Oxford, 82 returned to their own country, and one accepted work in England. Of 23 Germans, all returned home except one, who had accepted a teaching post in America. Of 78 colonial students, 12 are still engaged in courses of study preparatory to professions. Of the remaining 66, 51 have either returned already or are about to return to their own countries; four are teaching in England, but looking for colonial appointments in the future; one is for the present engaged in parochial work in England, with the view of service ultimately in his own colony; two have gone to colonies other than their own; three have accepted appointments in India; two, business positions in foreign countries; and three have decided to follow their professions in England. It is interesting to note that, of the total number of scholars, while 16 only took a distinctly classical course in the honour schools, 20 took up natural science, and that mathematics, forestry, and anthropology each attracted a few men only. Jurisprudence and history seem to have been the most popular subjects among the scholars.

SOCIETIES AND ACADEMIES.

London.

Royal Society, January 27.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir James **Dewar**: Long-period determination of the rate of production of helium from radium.—Sir James **Dewar** and Dr. H. O. **Jones**: Note on carbon monosulphide. No doubt decomposition is known which results in the direct production of a substance of the composition of carbon monosulphide. We have found that nickel carbonyl and thiophosgene react at the ordinary temperature according to the following equation:—

$$n\mathrm{CSCl}_2 + n\mathrm{Ni(CO)}_4 = n\mathrm{NiCl}_2 + 4n\mathrm{CO} + (\mathrm{CS})_n,$$

to produce a polymerised form of *carbon monosulphide*. The solid products were separated by treatment with water, and the insoluble residue, after drying at 150° C. under reduced pressure, was obtained as a very dark brown or black amorphous solid, which is sparingly soluble in some solvents, such as ethylene dibromide, carbon disulphide, and phenol, to give deeply coloured solutions. The solubility was not sufficient to enable the molecular weights by lowering of freezing point to be determined. The specific gravity of carbon monosulphide is 1·6, and hence its molecular volume is 27·5, while that of solid carbon disulphide is 52·4. A comparison of these values with the corresponding values for solid carbon monoxide (28) and carbon dioxide (28·7) shows that carbon monosulphide is formed from carbon disulphide with considerable condensation. On heating carbon monosulphide no change takes place below 360° C., but at a red heat it gradually decomposes into carbon disulphide and carbon. Carbon monosulphide dissolves in concentrated sulphuric acid to a brownish-purple solution, from which it is precipitated unchanged on the addition of water. It dissolves in alkalies to a dark brown solution, from which acids precipitate it unchanged. Other reactions are being investigated.—Sir W. de W. **Abney**: The extinction of colour by reduction of luminosity. In this paper the author gives the results of reducing the luminosity of all the rays of the spectrum to the point at which they become colourless when compared with white. The white itself varies in hue according to the amount of reduction in its luminosity. No notice is taken of this variation, so some parts of the spectrum do not require so much reduction to match the white as they would do if the white is kept of a uniform hue.—G. W. **Walker**: The initial accelerated motion of electrified systems of finite extent, and the reaction produced by the resulting radiation. The present investigation forms a development of a paper already communicated to the Royal Society (Proceedings, A, vol. lxxvii., p. 260). Its chief aim is to obtain, directly from the fundamental equations of electro-magnetism, a method of dealing with small disturbances from a steady state of motion, and thus avoid possible errors that may arise if one relies entirely on the principle known as that of the "quasi-stationary state." The method is explained in the first six sections, which include the problem of initial uniformly accelerated motion of a charged conductor of finite size, either from rest or from uniform motion in a straight line. It appears that the electric inertia calculated by this method does not always agree with the value obtained from the energy of a steady state. As the results obtained include the case of a conductor of small dimensions, several formulæ are compared with the experiments of Kauffmann on Becquerel rays, and a fair proportion of inertia of ordinary kind is found to be indicated by these experiments. Application of the method to uniformly accelerated linear and rotary motion of insulators has been made. It is found that the electric inertias for linear and rotary motions are the same, provided half of it is located at the centre and half is uniformly distributed over the surface of the spherical body, supposed an insulator. Several sections deal with vibratory motion of electrified systems. Some new features connected with emission and absorption, and dependence of frequency and damping on speed, are indicated.—H. **Thirkill**: The nature of magneto-kathodic rays. In the experiments described a variable longitudinal magnetic field acts upon an electric discharge. The experiments support the hypothesis that the luminous band, which, in a strong magnetic field, follows the direction of the lines of magnetic force and has the kathode for section, consists of slowly moving kathode rays. These have been bent by the magnetic field into the form of a very fine spiral. The charge was detected by using a sensitive galvanometer. On this view, the following facts observed by Villard and Righi are explained:—(1) the magneto-kathodic rays very often appear quite suddenly, and (2) their appearance is accompanied by an increased difficulty in detecting a charge on them; (3) the rays are deflected by an electric field in a direction at right angles to the directions of both the magnetic and electric fields; (4) the distance the rays extend from the kathode depends on the strength of the magnetic field. The conclusion arrived at is that there is not sufficient evidence to prove that the magneto-kathodic rays constitute a new kind of rays.—E. **Cunningham**: The velocity of steady fall of spherical particles through a fluid medium. In view of experimental work on the fall of small spherical particles through air, a discussion is made in this paper of two of the main causes of deviation from Stokes's law for the limiting velocity. The first effect considered is that arising from the radius of the particle being comparable with the mean free path of the air molecules. The following modification of Stokes's formula is obtained:—

$$W\left(1+\frac{1\cdot63\,l}{a(2-f)}\right)=6\pi\mu aV,$$

where l is the mean free path of the molecules of air, W is the weight, a the radius, and V the limiting velocity of a falling particle, f being a fraction depending on the nature of the surface of the particle, being unity for a perfectly smooth elastic surface. For most actual cases f probably lies between 0 and $\frac{1}{2}$. The formula agrees with Zeleny's recent experimental verification that for particles of radius greater than 10^{-4} cm. the deviation found is not large. The second effect discussed is that due to the simultaneous presence of a large number of particles distributed throughout the fluid, assumed in this case to be a continuous viscous medium. A formula is obtained which indicates that, as the number of particles per unit volume increases, the limiting velocity diminishes. The following table gives the ratio of the estimated limiting velocity (V^1) to that given by Stokes's law for different values of the ratio of a, the radius of the particle, to b, the mean distance between the centres of two adjacent particles:—

b/a	1·63	2·45	3·26	4·08	4·90	5·71	6·50	7·35	8·16	16·3	24·5	∞
V^1/V	7·29	3·02	2·10	1·76	1·57	1·46	1·38	1·32	1·28	1·14	1·08	1

—Dr. S. B. **Schryver**: The photochemical formation of formaldehyde in green plants. On the addition of phenylhydrazine hydrochloride, potassium ferricyanide and hydrochloric acid to solutions containing formaldehyde, a fuchsine-like colour is developed, by means of which the aldehyde, when present in small quantities, can be estimated. The reaction can also be applied to the estimation of formaldehyde when present in combination in such substances as oxymethylene tetramine, if the reaction mixture be boiled after addition of the phenylhydrazine reagent and before the addition of the ferricyanide and hydrochloric acid. By means of this method, formaldehyde can be readily detected when present to the extent of only one part in a million. The reaction has been applied to demonstrate the presence of the aldehyde in chlorophyll prepared from grass gathered after some hours of sunshine. The chlorophyll was extracted by alcohol, the solvent was then evaporated off, and the residue re-extracted with ether. In the product thus obtained, the presence of the aldehyde could be demonstrated after warming it or allowing to stand for some hours with the phenylhydrazine reagent. The ethereal solution of chlorophyll, on standing for some days, yielded a product which no longer showed the formaldehyde reaction. Formaldehyde was absent also in a sample of chlorophyll prepared from grass on a foggy morning. By exposing films of such aldehyde-free chlorophyll to sunlight in the presence of moist carbon dioxide, the formaldehyde reaction reappeared. Even in the absence of carbon dioxide slight traces could be detected after exposure to sunlight; in this case the carbon dioxide is apparently formed by photochemical decomposition of some constituent of chlorophyll. In the dark, formaldehyde was never generated. The results indicate that formaldehyde, as it is formed in plants, enters into somewhat stable combination with a constituent of the chlorophyll. Such a methylene derivative will, in the presence of water, undergo only slight hydrolysis, and equilibrium will be maintained in the presence of only a very small amount of free formaldehyde. As this is removed from the sphere of action by polymerisation or otherwise, the chlorophyll methylene derivative will undergo further hydrolysis, with the scission of further small amount of aldehyde. In this way the amount of free formaldehyde present at any moment in the plant can be regulated, and thus the highly toxic aldehyde will never be present in such quantities as to harm the plant.

Faraday Society, January 18.—Dr. F. Mollwo Perkin, treasurer, in the chair.—S. **Field**: The conditions which determine the composition of electro-deposited alloys. Continuing the study of the quantitative composition of electro-deposited alloys, those of copper and silver have been examined. For the electrolyte, a mixture of the double cyanides was again used. Ordinarily, silver is more negative than copper, but the difference in their character is such as would not seem to indicate any difficulty in depositing them simultaneously from a cyanide solution. The composition of the deposits was obtained by dissolving in nitric acid, and estimating the silver as chloride, except where the copper was obviously small, when that metal was determined. When a copper coulometer is in circuit the ratio (R) of the weights of alloy and copper deposited in the coulometer gives a figure from which, under ideal conditions, the composition of the alloy may be determined thus:—

$$\text{Percentage of silver}=\frac{241}{R}(R-2).$$

Experiments soon proved that simultaneous deposition only occurs within very narrow limits. Thus when the metals in the solution are in the proportion of even 1 equivalent silver to 34 equivalents of copper no deposition of copper occurs under ordinary conditions of current density, but when in the proportion of 1 equivalent silver to 100 equivalent copper, simultaneous deposition proceeds more readily.—T. P. **Burt**: The compressibilities of helium and neon. The compressibilities of the two gases were measured between the pressure limits of 850 and 150 mm. of mercury. With the object of determining the lie of the isothermals over this pressure range as accurately as possible, a large number of volume and corresponding pressure readings were made. On plotting pv against p, a straight line was obtained in the case of both gases. Helium was found to obey Boyle's law, the value of pv being independent of the pressure. In the case of neon, pv diminished as the pressure diminished, and the value of $d(pv)/dp.1/pv$ was found to be 0·00105.—Dr. A. C.

Cumming: Gas-washing bottles with a very slight resistance to the passage of a gas. Three forms are described. In one a short side-tube is joined to the inlet-tube of an ordinary washing bottle and bent upwards, so that the gas bubbles passing through it carry some liquid with them, causing constant circulation of same. In a second and more efficient form, the gas passes through a length of 5 mm. tubing, slightly inclined to the horizontal. Below this, and connected to its ends, is a bulb of liquid, so that here again the passage of gas through the tube causes a circulation of liquid. The third form described is a modification of the Richardson wash-bottle, in which the pressure is reduced by lengthening the nozzle through which the gas enters the washing bulb.—Dr. F. Mollwo **Perkin** and W. E. **Hughes**: Studies in the electro-deposition of metals. The authors describe a rotating kathode employed for rapid electro-deposition of metals. It consists of sheet platinum spun up so as to form a narrow thimble, the upper end being open and having a stout iridium wire fused to it. This electrode, which has an active surface of 16·3 cm., is rapidly rotated within a cylindrical platinum gauze anode. In other cases, particularly when graded potential methods are employed, a spiral anode of platinum is rotated within the gauze cylinder, which then functions as kathode. In the potential measurements a cylindrical glass funnel with a glass tube sealed in the side is employed for holding the electrode.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 3.

ROYAL SOCIETY, at 4.30.—The Thyroid and Parathyroid Glands throughout Vertebrates: F. D. Thompson.—The Transmission of *Trypanosoma lewisi* by the Rat-flea (*Ceratophyllus fasciatus*): Prof. E. A. Minchin and J. D. Thomson.—On the Relative Sizes of the Organs of Rats and Mice bearing Malignant New Growths: Dr. F. Medigreceanu.—Further Evidence of the Homogeneity of the Resistance to the Implantation of Malignant New Growths: Dr. E. F. Bashford and Dr. B. R. G. Russell.—The Contrast in the Reaction to the Implantation of Cancer after the Inoculation of Living and Mechanically Disintegrated Cells: Dr. M. Haaland.

RÖNTGEN SOCIETY, at 8.15.—The Essential Ambiguity of X-ray Representation, and some Methods of Solution: Dr. W. Cotton.

LINNEAN SOCIETY, at 8.—Further Discussion of the Origin of Vertebrates: Dr. A. Smith Woodward, F.R.S., Prof. A. Dendy, F.R.S., and other speakers, with Dr. Gaskell's reply.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Waves in Water, Sand, and Snow: Dr. Vaughan Cornish.

FRIDAY, FEBRUARY 4.

ROYAL INSTITUTION, at 9.—The Heredity of Sex: Prof. W. Bateson, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction and Setting-out of a Low-level Sewer: L. T. Wilson.

GEOLOGISTS' ASSOCIATION, at 8.—Presidential Address: Fifty Years' Work of the Association: Prof. W. W. Watts, F.R.S.

MONDAY, FEBRUARY 7.

ROYAL INSTITUTION, at 5.—General Meeting.

ROYAL SOCIETY OF ARTS, at 8.—The Petrol Motor: Prof. W. Watson, F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Manufacture of Ammonia-Soda; its Present State and its Future: Prof. A. Colson (Paris).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geographical Conditions affecting the Development of Australia: Prof. J. W. Gregory, F.R.S.

ARISTOTELIAN SOCIETY, at 8.—Kant's Account of Causation: A. D. Lindsay.

VICTORIA INSTITUTE, at 4.30.—Species and their Origin: Rev. John Gerard.

TUESDAY, FEBRUARY 8.

ROYAL INSTITUTION, at 3.—The Emotions and their Expression: Prof. F. W. Mott, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Notes on the Sheffield Water-supply and Statistics relating thereto: L. S. M. Marsh.—Statistical and Experimental Data on Filtration: W. R. Baldwin-Wiseman.

WEDNESDAY, FEBRUARY 9.

ROYAL SOCIETY OF ARTS, at 8.—Colour Blindness: Dr. F. W. Edridge-Green.

GEOLOGICAL SOCIETY, at 8.

THURSDAY, FEBRUARY 10.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Some Phenomena of Magnetic Disturbances at Kew: Dr. C. Chree, F.R.S.—On a Novel Phenomenon in the Diurnal Inequality of Terrestrial Magnetism: R. B. Sangster.—The Absorption Spectra of Vapours of the Alkali Metals: Prof. P. V. Bevan.—On the Shapes of the Isogeotherms under Mountain Ranges in Radio-active Districts: Prof. C. H. Lees, F.R.S.—On the Propagation of Disturbances in a Fluid under Gravity: F. B. Pidduck.—On the Flow of Water through Pipes and Passages having Converging or Diverging Boundaries: Dr. A. H. Gibson.—The Effect of Pressure upon Arc Spectra: Titanium: R. Rossi.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Losses off Transmission Lines due to Brush Discharge, with Special Reference to the Case of Direct Currents: E. A. Watson.

MATHEMATICAL SOCIETY, at 5.30.—A Note on Double-sixers of Lines: H. W. Richmond.—On the Diffraction of a Solitary Wave: Prof. H. Lamb.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Waves in Water, Sand, and Snow: Dr. Vaughan Cornish.

FRIDAY, FEBRUARY 11.

ROYAL INSTITUTION, at 9.—Electrical and other Properties of Sand: C. E. S. Phillips.

PHYSICAL SOCIETY, at 8.—Annual General Meeting. President's Address.

ROYAL ASTRONOMICAL SOCIETY, at 8.—Anniversary Meeting.

MALACOLOGICAL SOCIETY, at 8.—Unio, Margaritana, Pseudanodonta, and their Occurrence in the Thames Valley: Fritz Haas.—(1) Pleistocene, Holocene, and recent Non-marine Mollusca from Mallorca; (2) Marine Mollusca from Alcudia, Mallorca: Rev. R. Ashington Bullen.—Description of a New Species of Vivipara from New Guinea: H. B. Preston.—Description of a New Species of Unio from the English Wealden Formation: R. Bullen Newton.

SATURDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

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THURSDAY, FEBRUARY 10, 1910.

THE NUTRITION OF PLANTS.

Artificial Manures, their Chemical Selection and Scientific Application to Agriculture. By M. Georges Ville. Translated and edited by Sir William Crookes, F.R.S. New edition, revised by Sir William Crookes, F.R.S., and Prof. John Percival. Pp. xxxviii+347. (London: Longmans, Green and Co., 1909.) Price 10*s*. 6*d*. net.

SIR WILLIAM CROOKES and Prof. Percival have revised and re-issued the lectures given by Georges Ville at the experimental farm at Vincennes during 1867 and 1874–5, and originally translated by Sir William in 1879.

"It is only just," he says in introducing the volume, "that its claims to be regarded as a classic and its author's right to the title of pioneer should not be forgotten when many of Prof. Ville's views are so generally adopted that his prescience and acumen are likely to be underrated and his priority unrecognised."

Ville was an ardent supporter of Liebig's views on the nutrition of plants. He was one of the brilliant band of men who at that time were developing and spreading the new ideas; several of the lectures deal with his experiments showing that a full crop can be obtained by supplying the proper food-stuffs in inorganic combination. It is difficult for us now to realise the astonishment with which the older farmers saw crops raised solely by the aid of "chemical" manures without the dung which had always been supposed essential. Lawes and Gilbert showed that it was not; they also falsified the prediction of many of their critics that chemical manures would soon exhaust their land and leave it sterile. Ville went even further, and maintained that artificial manures were unquestionably more remunerative, and afforded, indeed, the only means of keeping up the fertility of the soil. A man who only used dung, he said, must exhaust his land. This is the characteristic note of a great part of the book.

The chemical manures were compounded on a definite plan. For each crop one of the three constituents nitrogen, potash, and phosphoric acid was found to be more necessary than the rest, and was therefore called the dominant constituent. Thus nitrogen was the dominant constituent for cereals and beetroot; potash for potatoes and vines; calcic phosphate for the sugar-cane; there was no dominant, however, for flax. An excess of the dominant constituent was always added to the crop manure.

Great stress was laid on the fundamental differences in nitrogen nutrition between leguminous plants and cereals; nitrogenous manures are not necessary for the leguminosæ, whilst they are for other plants. M. Ville had played a very prominent part in the great controversy that continued during many years as to the source of nitrogen in plants. It seems to have been begun by Priestley, who stated that a plant of *Epilobium hirsutum*, placed in a small vessel, absorbed during the course of a month seven-eighths of the air present. He therefore concluded that plants assimilated nitrogen, but this view was soon controverted by Ingenhousz, de Saussure, and others, and was for a time disposed of by the classical experiments of Boussingault. Ville, however, revived it, and his experiments, begun in 1849 and described in two very beautiful volumes, "Recherches expérimentales sur la Végétation" (1853 and 1857), appeared to show that all the plants examined, rape, wheat, barley and maize, actually did take some of their nitrogen from the air. Somewhat later, Lawes, Gilbert and Pugh repeated the experiments but failed to confirm the result. They even used his experimental vessels, which are still to be found among the treasures of the Rothamsted laboratory.

It is not our intention to discuss this discrepancy in the light of subsequent discoveries; we need only point out that Ville was perfectly correct so far as the leguminosæ are concerned, and that his error with regard to other plants did not lead him astray in making up his manures.

No value was placed upon soil analysis; "at the present time the most laborious analysis is not able to throw light upon the most vital and essential question of practical agriculture." The deficiencies of the soil are determined by trials with the plants themselves. Plots are directed to be laid out in the field as follows:—

(1) With the normal (*i.e.* complete) manure; (2) normal manure without nitrogen compounds; (3) normal manure without phosphates; (4) normal manure without potassium compounds; (5) normal manure without calcium compounds; (6) unmanured.

This is substantially the scheme now adopted in almost every county in England. Under his supervision large numbers of such experiments were carried out in France. Some of the results are astonishing. In one case a plot receiving 32 tons of farmyard manure per acre gave a crop of 14 bushels per acre whilst a neighbouring plot receiving half a ton of chemical manure per acre yielded 36 bushels. There was a loss of about 19*l*. in the former case and a gain of about 17*l*. in the latter.

Ville's main thesis that crops can be grown with chemical manures had already been demonstrated by Lawes and Gilbert, with whose names it will for ever be associated in England, and is now a commonplace in practical agriculture. His view that chemical manures are in all circumstances better than dung has not survived. He made no allowance for the wonderful effect of the organic matter present in the dung in improving the texture and water-holding capacity of the soil—an effect not shown at all, or even shown in an adverse sense, by artificial manures. When we remember how large a part of the farmer's labour is devoted to cultivation it is easy to understand his preference for dung. Indeed, on many soils addition of organic matter is absolutely indispensable. Further, it may be doubted whether we possess even yet the data necessary for working out the relative costs of farmyard and artificial manures in the complex conditions of modern farming, with its inter-dependence of crops and of live stock and its fluctuating financial equilibrium. Nor have Ville's formulæ for compound manures survived. The amount of food a plant requires is known to be modified by the water supply, the temperature, and the general soil conditions. It is clear that no one formula could possibly suit all cases; indeed, we might sum up the difference between Ville's views and those current now by saying that Ville regarded the supply of plant food as the dominating factor in determining fertility, whereas we now know it is only one of several equally important factors.

The lectures are interesting to read and must have been delightful to hear; they will form valuable material for the historian of agricultural science when he arises, not only by reason of the views set forth, but also because of the numerous balance-sheets and statements of costs. For their historical interest also they will be read by the serious student of agricultural chemistry, who indeed is already attracted to them by the fact that they have interested Sir William Crookes.

Certain alterations have been made in the text, so that the lectures are not quite in their original form. The editors have preferred to do this rather than to make corrections in footnotes, a plan which, if more cumbersome, would have had the advantage of preserving the historical value of the book. A chapter has also been added on the fixation of atmospheric nitrogen. All fixation methods attract much popular attention, while the electrical method first indicated by Sir William Crookes is already a rich and promising addition to our agricultural resources.

E. J. RUSSELL.

MODERN CHEMISTRY.

Handbuch der anorganischen Chemie. Herausgegeben von Dr. R. Abegg und Dr. F. Auerbach. Dritter Band, Zweite Abteilung. Pp. xii+921. (Leipzig: S. Hirzel, 1909.)

THIS stately volume of more than 900 pages treats of the elements of the fourth group of the periodic system, namely, C, Si, Ti, Ge, Zr, Sn, Pb, and Th. It opens with an excellent comparative summary by Abegg and Brauner of the general chemical and electrochemical relationships of the members of the group. Then comes a truly magnificent monograph on carbon by Weigert, covering 276 pages, with a literature-index containing 1307 references. It would be quite impossible in a short notice such as the present to give any adequate idea of the masterly manner in which the author has dealt with his great subject, so that a few references must suffice. In dealing with the allotropic forms of carbon, the usual purely descriptive account is followed by an extraordinarily interesting discussion of the energy- and stability-relationships, in which the researches of Schenck and Heller, and of Smits, are dealt with. The author also applies Nernst's theorem to the problem of the transition-point between diamond and graphite, but an arithmetical error appears to have crept into his calculation here.

The highly important theoretical and experimental researches on the formation, dissociation, and stability-relationships of the hydrocarbons are treated very fully, Nernst's thermodynamical theorem serving here (as elsewhere) as a basis for calculation. A good account is also given of Bone's work on the oxidation of hydrocarbons.

Under the heading of "Flame" the author does not fail to give us a lucid account of the modern work of Haber and his collaborators, whilst the subject of explosions introduces the reader to the work of Mallard and Le Chatelier and Dixon.

The chemistry of carbon has afforded the author a splendid opportunity of familiarising the chemist with the thermodynamics of high-temperature gas equilibria, and he has taken good advantage of it. The treatment of such highly important subjects as the dissociation of CO_2, the $C—CO_2—CO$ equilibrium, the water-gas equilibrium, and various heterogeneous gas-equilibria, such as $C—N—C_2N_2$, $C—S—CS_2$, $C—NH_3$ $HCN—H$, is excellent. The treatment of these matters brings the author to the discussion of such fundamental questions as the free energy of carbon combustion and the quantitative measure of the reducing power of carbon and its simpler gaseous compounds. What a vista is opened here to those who have the eyes to see and the minds to understand! It is a painful reflection to realise how soon all this will be as familiar to the trained modern German chemist as the laws of Dalton and Avogadro, whilst the progress of scientific chemistry in this country is still retarded by the false prophets who are affrighted by the sight of an algebraical symbol, and grievously lament the advance of physical chemistry.

There is an excellent and suggestive account of photochemical plant synthesis, and of the free-energy changes involved in biological metabolisms.

The heterogeneous equilibria presented by solid CO_2 in its various forms, and the ionic dissociation of aqueous solutions of carbonic acid, are well treated. More technical questions, such as the manufacture of coal gas, the calorific power of fuels, and the light efficiency of burning oils, come in for their share of discussion.

Enough has been said to give some idea of the scope and method of this splendid monograph. It is to be sincerely hoped that English chemists will carefully study it.

The next article (by Grossmann) deals with silicon and its compounds, and is full of interesting things. As befits the theme, a very full account is given of SiO_2, the silicic acids, and the silicates. Here we find an excellent *résumé* of Tschermak's interesting researches on the constitution of the silicates, together with the criticisms of Jordis, van Bemmelen, and Mügge thereon.

Another very interesting section deals with the work of Vogt, Doelter, and Allen and Day on the silicate melts.

Silicon is followed by a compact and up-to-date article of twenty pages on glass, by Schaller.

Titanium is dealt with by Jacoby. Here we find a very full discussion of the important work of Diethelm and Foerster on the electrochemical reduction of acid titanic sulphate solutions.

Germanium and zirconium are well presented by

G. Rudorf and R. J. Meyer respectively, after which comes, if we may so express it, another *pièce de résistance* in the shape of a splendid article on tin from the pen of Ernst Cohen. In this is to be found a very scholarly and learned essay on the early history of this metal, and an exhaustive and beautifully illustrated account of that romantic and fascinating subject, the allotropic forms of metallic tin. As is well known, the chemistry of tin owes much to the researches of Cohen, and we are not disappointed in expecting to find his treatment of the subject exceptionally full and interesting.

Tin is followed by a long monograph on lead, by Ahrens and Pick. Here again the reviewer feels it his pleasant duty to bestow unstinted praise. The article opens with a very full account of the metallurgy of lead. The fundamental researches of Schenck and Rassbach on the heterogeneous equilibria between PbS, $PbSO_4$, PbO, and SO_2, are dealt with, however, under PbS. The electrochemical relations between lead and its ions are clearly and fully explained, including the work of Cumming on the oxidation-potentials of PbO_2. The chemistry of lead and its compounds offers many interesting points, all of which afford the author good opportunities for demonstrating the power and scope of physico-chemical methods of attack. Amongst these may be mentioned the work of Pleissner and Auerbach on the basic sulphates and carbonates of lead, the work of Pleissner and Auerbach and of Dolezalek on the solubility of $PbSO_4$ in water and sulphuric acid solutions, the work of Lewis on the solubility of $Pb(NO_3)_2$ in solutions of KNO_3 and $NaNO_3$, the stabilities and mutual relations of the oxides of lead, &c. In connection with the latter subject, the author has, however, missed the work of Brislee on Pb_2O.

In dealing with the demonstration by Allmand and Denham of the existence of *monovalent* lead ions, the author suggests by way of criticism that the experiments alluded to could be explained in another way, *i.e.* by the assumption of the existence of complex kations of the formula $Pb_2^{\cdot\cdot}$. These might still be *monovalent* ions, and the assumption by Allmand and Denham of the simpler formula $Pb^{\cdot}$ remains the best explanation until the existence of such complex kations is experimentally demonstrated.

After lead comes an article on the lead accumulator, by Mugdan. Needless to say, the article is chiefly concerned with the thermodynamic theory as worked out so beautifully by Dolezalek, although due mention is made of the early work of Faure, Planté, Gladstone and Tribe, and Streintz. This excellent article may be earnestly commended to the attention of electrical engineers. The usual English treatises on the lead accumulator consist of constructive details plus a little perfectly useless juggling with chemical symbols.

Thorium, the last member of the series, is dealt with by R. J. Meyer. Here is to be found an excellent account of the manufacture and optical (selective radiation) theory of the incandescent gas mantle.

Throughout the book colloidal states of matter are treated by Lottermoser. Of especial interest are the articles dealing with those classical examples, silicic and stannic acids.

Atomic weights are dealt with by Brauner in masterly fashion.

On laying down this wonderful volume, one cannot help feeling, as in the case of its predecessors, that Abegg's great undertaking marks the beginning of an era, the era of scientific inorganic chemistry. One realises with a spirit of rejoicing that inorganic chemistry has become a rational science of which every chemist may justly feel proud. The day of the why and the wherefore has dawned. One may beg leave to reason in inorganic chemistry as in other exact sciences. What middle-aged chemist of the present day can forget the inorganic chemistry of his youth, with its alchemistic recipes, its dry lists of formulæ, and its grim determination to explain *actions* by means of symbols invented to describe the *static* facts of composition? It was in truth little more than a sort of glorified black magic. Even at the present day there are not wanting signs that this sort of thing is not entirely dead. How many of our young graduates could read and thoroughly understand the pages of Abegg's "Handbuch"? One would not like to hazard an answer to that question, and yet on that answer depends very largely the hope of future progress. The methods of physical chemistry have converted the empiricism of the older inorganic chemistry into the rational science of to-day. The same tremendous transformation is fast approaching in the sphere of organic chemistry. Other things being equal, the victory lies with those who can best command the keen-edged weapons of physics and mathematics.

F. G. D.

TWO MAMMAL BOOKS.

(1) *The Grizzly Bear: the Narrative of a Hunter Naturalist, Historical, Scientific, and Adventurous.* By W. H. Wright. Pp. x+274; illustrated. (London: T. W. Laurie, 1909.) Price 7*s*. 6*d*. net.

(2) *The Animals and their Story.* By W. P. Westell. Pp. 322; illustrated. (London: R. Culley, n.d.) Price 5*s*. net.

(1) A VERY cordial welcome should be extended to Mr. Wright's intensely interesting volume, which has an exceptional value as embodying the experiences and opinions of a man who has hunted the great bear of the Rocky Mountains at a time when it was more numerous than is at present the case. The author tells us that he was born in New Hampshire in 1856, and that some time after 1883 he commenced bear-hunting during such intervals as could be spared from his business. Later on, in 1889, hunting became his profession, and he was seldom long away from the woods, his trips being sometimes made alone, but more frequently with companions who desired to be initiated into the mysteries of bear-stalking, and were able and willing to pay for the privilege.

"In the beginning," he writes, "I studied the grizzly in order to hunt him. I marked his haunts and his habits, I took notice of his likes and dislikes. . . . And then at last my interest in my opponent grew to overshadow my interest in the game. . . . I came to hunt him in order to study him. I laid aside my rifle. It is twelve years since I have killed a grizzly. Yet in all those years there is not one but what I have spent some months in his company. And then (alas! that it had not been sooner) I undertook to photograph him."

The book commences with an account of the early history of the species, as given by Lewis and Clark and subsequent writers; and the author discusses whether the animal ought to be called the grisly (meaning fierce) or grizzly (grey) bear. He decides in favour of the latter, although admitting that Lewis and Clark used grisly (perhaps in the sense of grey), and that Ord gave the name *horribilis* as the Latin equivalent of grisly in its proper sense. In our own opinion this usage ought to be followed.

To follow the author through his bear-hunting and "bear-snapping" experiences is, in our limited space, impossible, and we must be content in directing attention to the beauty and interest of his photographs of grizzlies in their native wilds. Very interesting, too, are his pictures of the slots of the grizzly and the black bear, showing how widely they differ from one another. The front claws of a grizzly are generally described as being whitish and nearly straight; but the author shows that the latter definition is incorrect, and that they are better described as narrower and less sharply curved than those of other bears.

The book is teeming with interest, and may be cordially recommended to naturalists and sportsmen as a trustworthy account of a disappearing species.

(2) Commendation of a like nature can, we regret to say, scarcely be accorded to the second of the two works forming the subject of this notice. Mr. Percival Westell is a voluminous writer on the fauna of Britain and various groups of invertebrates, but has hitherto, we believe, not tried his hand on mammals as a whole. In the present volume he has attempted to give an account of a selection of the more interesting types of the class, especially those represented in the London Zoological Gardens, arranged according to the nature of their environment, and illustrated with a number of photographs and coloured plates. The photographs are for the most part worthy of all praise, while the execution of the coloured plates is also good, although it is a pity that in some instances—notably the one of the wapiti—the artist was furnished with such poor models.

The volume is confessedly a compilation, largely made up of extracts from the writings of Mr. Selous and two well-known works on natural history—one, by the way, somewhat out of date. When he confines himself to direct extracts from these Mr. Westell does not wander far from the right path, but when he draws material from his own mind the result is disastrous. We are calmly told, for instance, on p. 245, that, in consequence of the domestication of the species, there are probably no wild yak in Tibet; while from the text and figure on pp. 245 and 246 the author would appear to be labouring under the impression that the cows are hornless. On p. 139 we are informed that it is the brindled, instead of the white-tailed, gnu that is verging on extinction; while from the statement on p. 314 it would appear that the author is quite unaware of the existence of the white rhinoceros in Lado and the Bahr-el-Ghazal, where it is not in the least danger of extermination. Striped elands (p. 174) are said to occur in northern Africa, where there are no elands at all; Grévy's zebra (p. 114) is stated to have been discovered by Grant and Speke; and the roebuck is affirmed to be a near ally of the muntjac (p. 113). As instances of carelessness we may mention (p. 267) *Kabern* for *Kaberu*, and (p. 220) *arin* for *arui*. To quote Mr. Ingersoll (p. 242) as the authority for the absence of deer from Ethiopian Africa is about equivalent to referring to Sir Robert Ball as sponsor for the rising of the sun to-morrow morning; while the statement on p. 304 with regard to the distinctness or identity of the European and American beavers is absurd.

Many other blunders and instances of carelessness might be quoted, but the foregoing are sufficient to indicate the untrustworthy nature of Mr. Westell's book.

R. L.

RELIGIO PHYSICI.

Man and the Universe: a Study of the Influence of the Advance in Scientific Knowledge upon our Understanding of Christianity. By Sir Oliver Lodge, F.R.S. Pp. viii+356. (London: Methuen and Co., n.d.) Price 7s. 6d. net.

IN this vigorous and attractive work Sir Oliver Lodge has gathered into a more or less systematic whole his well-known views upon the relation between science and religion. The result is a "Religio Physici" which recalls its famous prototype as much by contrast as by similarity. Sir Oliver Lodge, like Sir Thomas Browne, is at once a man of science and a sincere and candid friend to religion, but his apology for this position is far from a mere demonstration that a whimsical temperament can (by a *credo quia impossibile est*) hold incompatibles in conjunction. Nor does he follow the dangerous precedents of later apologists, who have strained analogies to prove that science and orthodox Christianity, so far from being at loggerheads, are really in perfectly amicable agreement. There is, admits Sir Oliver, "an outstanding controversy" between orthodox men of science and orthodox theologians, "although active fighting has been suspended." The reason for this controversy is "that the attitudes of mind appropriate to these two classes" are "at present fundamentally diverse." Such being the case, the only hope of reconciliation lies in the admission on the part both of man of science and of theologian that neither is in occupation of the sole point of view from which truth is visible. In particular, the man of science must learn

> "that it is a sign of unbalanced judgment to conclude, on the strength of a few momentous discoveries, that the whole structure of religious belief, built up through the ages by the developing human race from fundamental emotions and instincts and experiences, is unsubstantial and insecure."

In place of such partisan exclusiveness we must cultivate the conviction that science and religion both contain systems of truth which must ultimately prove to be congruent: "the region of true religion and the region of completer science are one."

In pursuance of this plan of reconciliation, Sir

Oliver Lodge once more presses upon the physicist his favourite argument (formerly urged in these columns) that the universal operation of formal laws such as the conservation of energy, still leaves room for intelligent "guidance and control"—and may even be compatible with the efficacy of prayer. Further, he recommends more serious attention to the better established data of "psychical research," and the hypotheses as to the nature of human personality based upon them—since both data and hypotheses have an important relation to certain contents of orthodox Christian doctrine. To the theologian he commends a more frank acceptance of the established results of scientific inquiry, counselling him to base his system neither on facts of a negative kind (such as the biologist's present inability to trace the origin of life) nor on single historical events of an alleged miraculous order, but to found it upon the ever-present facts of human nature and experience. The synthesis of this "completer science" with this "true religion" would yield what the author regards and defends as an anthropomorphic pantheism.

Sir Oliver Lodge is evidently aware that professed theologians will regard his work in their department with little more than the politeness due to a distinguished amateur. It is to be feared that the professed philosopher will adopt a similar attitude towards his metaphysics, while, no doubt, there are physicists who remain unconvinced by the doctrine of "guidance." Nevertheless, the book will be read with approval and profit by a great many persons of moderate opinion, who, in matters that affect life as a whole, are disinclined to submit to the tyranny of the departmental expert. Moreover, it will be commended to most readers, not only by the writer's characteristic fairness and sincerity, but also by a tenderly reverent and sometimes eloquent treatment of certain topics unsuitable for specific discussion in this journal.

The reviewer has to express his regret for the late appearance of this notice, for which he alone is responsible. T. P. N.

MATHEMATICAL PRINCIPLES AND PRACTICE.

(1) *Descriptive Geometry.* A Treatise from a Mathematical Standpoint, together with a Collection of Exercises and Practical Applications. By Prof. V. T. Wilson. Pp. viii+237. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 6*s*. 6*d*. net.

(2) *Practical Arithmetic for Schools.* By W. G. Borchardt. Pp. viii+445+lxxvi. (London: Rivingtons, 1909.) Price 4*s*. 6*d*.

(3) *The Calculus and its Applications.* A Practical Treatise for Beginners, especially Engineering Students. By R. G. Blaine. Pp. ix+321. (London: Archibald Constable and Co., Ltd., 1909.) Price 4*s*. 6*d*. net.

(1) PROF. WILSON'S "Descriptive Geometry" is "a treatise from a mathematical standpoint." The author believes that the subject has "suffered mutilation in the interests of short cuts to immediate practical uses," and his aim has been to "refrain from any attempt to hold the student's interest by clothing a few principles with some immediate practical application." From this point of view he has succeeded in producing a sound and excellent work. In the chapters on the point, line and plane, the theorems and principles on which the constructions are based are formally and clearly set out. The scope of the book embraces a general classification of lines and surfaces, including developable surfaces such as the cylinder, cone and convolute; warped surfaces like the hyperbolic paraboloid, conoid, and helicoid; and double curved surfaces, for example, the sphere, ellipsoid, &c. The projections, tangencies, intersections and developments of these surfaces are dealt with. As each new problem is stated, its general solution is first given with reference to the principles involved, and this is followed by a drawing showing the full construction for a particular case; this seems to be an admirable method, conducive to clear thinking and a thorough grasp of the subject.

A collection of exercises and some suggestions for practical applications are provided in the last chapter, and the volume closes with a very complete index. Anyone who has mastered the contents of this book will have no difficulty in applying his knowledge to any practical cases that are ever likely to arise.

(2) The arithmetic by Mr. Borchardt will rank with the best of the recent text-books on the subject. It follows the latest developments, which are now so well known as to render superfluous any detailed description. The requirements of the counting-house, workshop, and laboratory are fully met. The exercises are abundant, carefully graded and of diversified interest, and test papers and copies of recent examination papers are provided. The book is divided into two parts, which may be obtained separately or under one cover, and with or without answers. This school arithmetic cannot fail to give full satisfaction wherever it is used.

(3) "The Calculus and its Applications," by Mr. Blaine, covers a considerable extent of ground, including the differentiation of hyperbolic functions; successive and partial differentiation; maxima and minima of functions of one and two variables; Taylor's theorem; integration by analytical, mechanical and approximate methods; double and treble integrals; differential equations, solutions by symbolic methods; and a chapter on periodic functions and harmonic analysis. The subject is not developed by the author in any very strict logical sequence, and the book is not suitable for beginners working without the aid of a teacher. The principal feature of the work is the large collection of examples illustrating the application of the calculus to practical problems in mensuration, physics, mechanics, and engineering. These are extensively used in the text to explain the significance of the symbols and the operations of the calculus, and are provided at short intervals as exercises for the student. Teachers will value the book mainly on account of the interest and variety of these practical problems.

OUR BOOK SHELF.

A Primer of Statistics. By W. Palin Elderton and Ethel M. Elderton. Pp. viii+86. (London: A. and C. Black, 1909.) Price 1*s*. 6*d*. net.

In his Herbert Spencer lecture of 1907, Sir Francis Galton outlined a suggested course of "Object-lessons in the Methods of Biometry," adapted to persons with no mathematical knowledge. The course was to consist of five lessons, the first to introduce the learner to the idea of variability and the median, the second to deal with the scheme of distribution (the ogive curve), the third with deviations from the median, the fourth with frequency curves (including the arithmetic mean and the standard deviation), and the fifth with correlation.

The present little volume owes its genesis to this suggestion of Sir Francis Galton, who contributes a short preface, and it follows very much the lines he laid down, with the addition, however, of a chapter on probable errors. The style is for the most part very simple, and the volume should be of real service to biological students and others who desire to obtain a general idea as to the meaning of the terms used in modern statistical methods. A few statements seem, however, to be open to criticism. The student ought not to conclude that "shells possess a mid-length (or median) which is constant in different samples" (p. 6) when he has only examined *two* samples. It is hardly correct to state that "when the difference between two means exceeds three times the probable error, then it is considered to be certain that the difference is significant" (p. 79); it is merely moderately likely. Finally, while it is true that the theory of errors of sampling "depends on the assumption that the things dealt with have been taken at random" (a word which does not appear to be defined), we cannot agree with the unqualified statement that "the collection of statistics in any other way is sheer waste of time," nor that "it is far better . . . to take 5000 or 6000 cases at random . . . than to take 50,000 which are specially chosen" (pp. 82–3); the contrary, indeed, may often be the case.

In the first chapter, we also suggest, it would be better to use longer series as illustrations; Figs. 2, 3, and 5, especially, hardly suggest the true form of the "ogive" to anyone who is not prejudiced by a wider experience than the readers of this book are assumed to possess, and scarcely justify the statement made on p. 6 as to the form of the curve. A second edition of this little volume is sure to be called for, as it fills a distinct gap in statistical literature, and the points mentioned might receive consideration.

All About Ships and Shipping: a Handbook of Popular Nautical Information. By Commander R. Dowling, R.N.R. With a Preface by Commander W. F. Caborne, C.B., R.N.R. Third edition, revised. Pp. xvi+429. (London: Alexander Moring, Ltd., 1909.) Price 5*s*. net.

This is the third edition of a handbook of popular nautical information. It has been compiled by a seaman, and is intended largely, if not chiefly, for the use of general readers. At the same time, it contains much which will interest sea-going folks. It claims to be corrected up to date, but in some sections this can hardly be said to have been accomplished. This is particularly true of information given in regard to warships. For instance, the short chapter dealing with submarine boats does not go beyond the "A" class, whereas last year the "D" class had been reached. The latest developments in battleships are better dealt with, but the inevitable compression which has to be accepted in a book of very moderate size dealing with a great mass of miscellaneous information has resulted in meagre descriptions of types of ships both in war fleets and in mercantile marines. No pretence at originality is made by the author. His task has been one rather of collection and compression of information, and the attempt is, on the whole, fairly successful. The book would prove a pleasant companion to people taking long sea-voyages or short pleasure cruises who desired to identify vessels of different nationalities and different mercantile lines of steamships, or who wished to understand something of the *technique* and vocabulary of the seafaring profession.

In any future edition of the book Commander Dowling would confer a favour upon his readers if references were given which would enable anyone so desiring to turn to larger and authoritative works bearing on the very great number of subjects treated, many of which are necessarily described by him in barest outline. It must not be understood that Commander Caborne fails to acknowledge his indebtedness to others for facts and information; the only fault is that no systematic references are made to places from which information has been drawn. If he introduced another appendix dealing with the bibliography of ships and shipping, it would certainly be welcomed by those who take an interest in maritime affairs, and desire fuller information than can be expected to be found in a pocket book.

Van Nostrand's Chemical Annual, 1909. Second issue. Edited by Dr. J. C. Olsen. Pp. xii+580. (London: Constable and Co., Ltd.) Price 12*s*. 6*d*. net.

The first edition of this "Annual" was published in 1907, and was reviewed in Nature of January 23, 1908. The second issue, which has recently come to hand, has been increased in size by some eighty pages, and contains a considerable amount of new matter, including a table of the physical constants of the alkaloids, by Dr. A. Seidell, and a similar table for the essential oils, by A. E. Secker, who has also revised the tables on fats and oils. Prof. Parr's recently calculated table of the densities of carbon dioxide has been inserted, and also a table showing the melting points and the composition for a number of fusible alloys.

The table of gravimetric factors and their logarithms has been entirely re-calculated on the basis of the international atomic weights for 1909, which involved an unusually large number of alterations. The review of chemical literature and the list of new books give the titles of all important publications which have appeared since the first issue.

The publishers have, we think, been well advised in abandoning the attempt to present a fresh issue every year. Although important alterations in the recognised constants are made from time to time, the majority hold good for long periods, and there cannot be many chemists who would care to purchase a fresh volume of tables every year for the sake of the limited number of alterations that may be made. It appears, indeed, to the writer that the interval between successive issues might with advantage be extended to four or five years, so as to avoid burdening the bookshelves of the purchaser with a number of volumes in which the same tables are of necessity repeated again and again. The attempt to combine tables of reference with reviews of current literature can only be expected to achieve success through a compromise of this character. L.

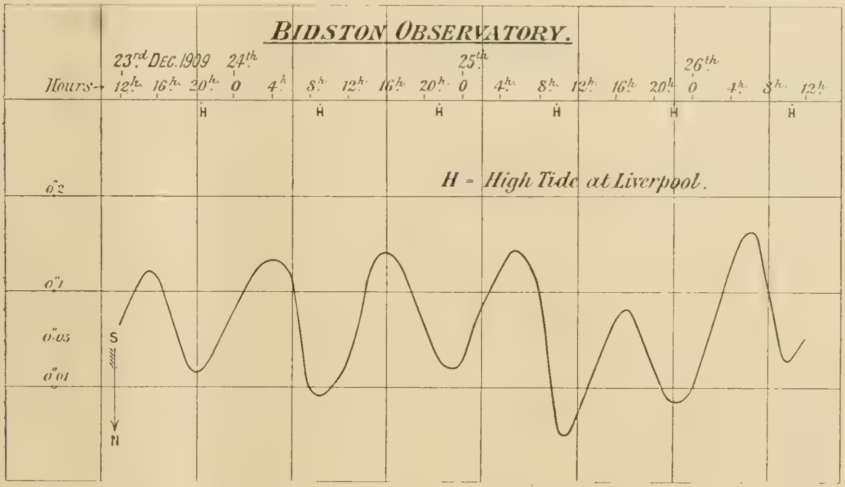
LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Surface Deformation and the Tides.

FOUR years ago I installed in a cellar beneath the Victoria Club, at Ryde, an astronomical level. It was oriented at right angles to the shore-line, only a few yards distant. At the time of high water I found, contrary to my expectation, that the strand, rather than sinking, rose upwards. This I attributed to the tide backing up underground drainage beneath the land, which in consequence bulged upwards. Sir George Darwin, however, makes the suggestion that my observations might be explained on the assumption that the load of water in the English Channel on the south of the Isle of Wight might reverse the effect of a smaller body of water in the Solent on the north side.

I was enabled to make a second attempt to measure the changing slope along a coast in consequence of tidal influences through the kind cooperation of Mr. W. E. Plummer, the director of the Bidston Observatory. This observatory is situated near Birkenhead, about one and a half miles from the sea. The instrument is a slightly modified form of a British Association type of seismograph. It consists of a horizontal boom, 2 feet in length, carrying a weight of 6 lb. At the outer end of the boom there is an extremely light lever, which multiplies the movement of the boom eight times. This, which is a peculiar feature of the apparatus, was designed by my assistant, Mr. Shinobu Hirota. The outer end of this pointer moves above a surface of bromide paper driven by clockwork. A displacement of the image shown on the paper through a distance of 1 mm. corresponds to the displacement which would be obtained were the stand of the pendulum tilted through an angle of 0·08″. The objects of this installation are two-fold, first, to record tidal effects, and, secondly, to pick up minute movements which other types of seismograph seldom record. The accompanying figure shows the tidal effect, which varies with the height of the water, the ebb, and the flow.



The movement of a Horizontal Pendulum at Bidston, December 23–6, 1909. The bob moves to the North with a rising tide. Scale $\frac{1}{16}$ in. = 0·01 second of arc.

At high tide the bed of the Irish Sea is depressed, and the steepness of the bounding shores is increased. The buildings in towns along sea-boards twice a day are tilted seawards. When the tide flows out these movements are reversed. The deflection of the pendulum by tidal load and attraction, although greater than might be expected, is, however, very small. At Bidston it is about 0·2″, or 1 inch in sixteen miles.

JOHN MILNE.

Shide, Isle of Wight, January 24.

A Possible Identification of Comet 1909e.

HERR EBELL has recently determined approximate elliptic elements for this comet.

These elements bear some resemblance to those of comet 1890 VII. Spitaler, which has a period of 6·373 ± 0·01 years, and has not been seen again.

Comet Spitaler had a perihelion distance of 1·8 and an aphelion distance of 5·1. It passes near no other planets than Mars and Jupiter. The small mass of Mars makes the perturbations by that planet of little account.

As comet Spitaler's period is half that of Jupiter, it only approaches Jupiter at alternate aphelion passages. It did not approach Jupiter at its aphelion after its appearance in 1890, but it did approach Jupiter on the following aphelion passage, 1899–1900.

The comet's motion is direct, and it therefore remains in proximity to Jupiter for a considerable time. Its closest approach took place about 1899 November 8, when its distance was about 0·6 and its eccentric anomaly 160°. For more than a year it remained within a distance 0·8 of Jupiter, and the perturbations must have been considerable. If we carry Ebell's orbit backwards, we see that comet 1909e was also near Jupiter in 1899–1900, and there is, therefore, a fair probability of the two comets being the same.

If Ebell's elements were definitive, this identification would have to be given up, for a rough calculation shows that the changes of elements are not in the right direction or of the right magnitude. Ebell's elements, however, merely represent the first attempt to get elliptic elements instead of parabolic elements. They depend on three places only, the first and last being six weeks apart. Herr Ebell himself tells us that the residuals for a fourth observation in the middle of the above-mentioned six weeks amount to a minute of arc, so that it is quite conceivable that the errors of the elements are of the same order as the perturbations by Jupiter.

These perturbations by Jupiter depend upon the exact circumstances of the approach to Jupiter, and these circumstances in their turn may be largely modified by changes in the elements quite small enough to be consistent with the three months' observations in 1889–90. There is, therefore, great uncertainty as to where comet Spitaler should now be, and also some uncertainty as to what are the true elements of comet 1909*e*.

Identity is therefore very far from certain. The excuse for putting forward the present conjecture is the interest that naturally turns upon the question of what becomes of the short-period comets that are only once seen.

P. H. COWELL.

Pleochroic Halos.

IN a recent reference to the subject of pleochroic halos (*Phil. Mag.*, February, 1910) I stated that the outer edge of a corona might present an appearance suggesting an actual accentuation or deepening of the coloration, in accordance with the fact observed by Bragg and others that the ionisation of the α ray increased just before the limits of its ionising range was attained. For certain stages of development of the halo, this observation I have more recently confirmed beyond doubt. Like other structural particulars referred to in my paper, this too becomes obliterated by over-exposure. In one case (in the lithia mica of Zinnwald) a stage of development has been found in which the extreme outer border of the corona is the sole visible part of that structure, the appearance presented being that of a detached, very delicate, ring of perfect regularity surrounding the central halo, a space showing no definitely visible ionisation intervening. The outer ring has a radius of 0·0344 mm., and the inner halo a radius of 0·0191 mm. The outer ring is of about normal radial dimensions; the inner radius is that corresponding to under-exposure to the slower moving α particles. Reference to Bragg's curves (*Phil. Mag.*, September, 1905) will more fully explain.

In the granite of Ochsenkopf, Fichtelgebirge, complex halos will be found very beautifully developed. Some of these conform to dimensions such as might be referred to the α radiations of thorium and its derivatives, others to those of the radium family.

The halos described in my paper, referred to above, are for the most part in a lithia-bearing mica, of a kind which is not correctly included among the Muscovites. The emendation does not, however, notably affect the calculations given. The careful observation of the dimensions of pleochroic halos will, I think, be found of service in distinguishing certain micas—the Biotites from the Muscovites, for instance.

J. JOLY.

Trinity College, Dublin, January 31.

Dangerous Lecture Experiments.

THE explosion referred to by Mr. Power in NATURE of February 3 (p. 399) was probably due to the presence of a trace of moisture in the reacting substances. I had a similar alarming experience some years ago, using precipitated silica without specially drying it.

Moissan ("Traité de Chimie Minèrale," ii., 389), referring to a paper by Ludwig Gattermann (*Ber.*, xxii., 186, 1889), states:—"La réaction ($SiO_2+2Mg=Si+2MgO$) est si violente, d'après cet auteur, que si l'on emploie la silice précipitée, le tube de verre est entièrement déformé, et une partie le la matière est projetée sous forme d'une gerbe de feu." Winkler (*Ber.*, xxiii., 2652, 1890) found that 0·2 gram of a mixture of magnesium and silica in the above proportions heated in a tube closed at one end caused explosion and shattering of the tube. Vigoroux (*Annales de Chimie et de Physique*, xii., 153, 1897) recognised that the explosion is due to incomplete desiccation of the reacting materials.

Few text-books point out the necessity for ensuring the absence of moisture, although most of them point out that the reaction is very rapid and violent. The only book besides Moissan's "Traité" that I have found to give the warning is by an American, Dr. Benedict ("Chemical Lecture Experiments," The Macmillan Company, New York, 1901). Dr. Benedict insists upon the absence of moisture, but does not mention any reason.

This is not the only case in which dangerous experiments have been described and copied from one text-book to another. The collection of hydrogen from the action of sodium upon water is a case in point. Many books describe, with a diagram, the "drowning" of a piece of sodium by means of a special instrument of wire gauze. This *may* be carried out safely in some instances, but, as Newth points out, it is liable to be dangerous. Upon one occasion in my own experience, using a small piece of sodium, an earthenware pneumatic trough was shattered as well as the gas jar used to collect the hydrogen.

It would seem desirable that writers of text-books should obtain some personal knowledge of the experiments they recommend, as young teachers, relying upon the instructions given, might easily cause very dangerous accidents. In neither of the cases cited above would a chemist, unless fairly experienced, be likely to apprehend any difficulty or danger.

E. R. MARLE.

Hartley University College, Southampton.

THE letter of Mr. Power in NATURE of February 3 directs attention to a danger common to the use of any of the metallic reducing agents, and, although well known to a few for many years, it is not at all generally recognised. Even the well-known reaction

$$Fe_2O_3+2Al=Al_2O_3+2Fe,$$

if performed in the way described, is positively dangerous unless all the precaution necessary for a violent explosion be taken.

A very striking lecture experiment is to charge a tiny steel crucible that will contain about one-half up to one cubic centimetre of a mixture of ferric oxide and finely powdered aluminium, and to cover it loosely with a thin sheet-iron cover so as to preserve the contents from water vapour, and then to heat this up in a little furnace made of strong iron gauze covered with asbestos and held rigidly in a retort stand. An ordinary blow-pipe with a foot blower will be sufficient, and the reaction is so violent, as soon as the necessary temperature is attained, that in nearly every case the steel crucible will be shattered into pieces, notwithstanding the lightness of the cover.

The possibly dangerous character of the reduction was noticed by me certainly so long ago as 1896 whilst preparing special qualities of iron experimentally in the South Kensington laboratories, and shown to many persons. Even then it may have been not unknown to other workers with metals, although new to us; and although the mixture was at once respected, and absorbents of heat were used in the charge to moderate the action, I am aware of at least one narrow escape by an operator who wished to verify the observation and used a quarter of a kilogram of the mixture in a crucible heated by a Fletcher oxygen injector furnace, the pieces of which were thrown all over a large room, fortunately without striking any person.

The explanation is simply that the preliminary heating to the temperature of reaction is sufficient to enable the mixture to reach the volatilisation point of the iron by the heat suddenly evolved throughout the mass, and thus there is practically detonation; but it also suggests that some danger of explosion exists should a store of the mixture be involved in a fire, and these mixtures are now in fairly common use industrially.

HENRY C. JENKINS.

The School of Metalliferous Mining (Cornwall),
Camborne, February 5.

The Maintenance of Forced Oscillations.

PLEASE permit me to add a few words to my note on "The Maintenance of Forced Oscillations of a New Type," which appeared in NATURE of December 9, 1909. I stated that when a vibrating fork maintains the vibration of a string by periodically varying its tension, the stationary oscillation maintained may have a frequency of half of, equal to, 3/2 times, twice, &c., of that of the fork, each term in the harmonic series appearing separately by itself, or with one or more of the others conjointly, according to circumstances.

When two or more of the harmonics thus appear conjointly, they generally are not all in one plane of vibration; in other words, one or more appear in a plane which is normal to that of the others, and this can always be secured by a manipulative device. The paths described by any point on the string would in such circumstances be curved figures identical with, or analogous to, the well-known figures of Lissajous.

I send two photographs (Figs. 1 and 2), each only 3 cm. by 2 cm., showing a short length of the string with a brilliant point in the middle of it, when executing such oscillations. The curves shown in them are only two out of a large number that I have observed and photographed, and can be recognised to be both compounds of the first three harmonics in the series mentioned above. It is difficult at first mentally to picture the process by which a tuning-fork executing normal oscillations maintains a string permanently in an oscillation of the type shown in the photographs.
C. V. Raman.

Post-Box 59, Rangoon.

A Tertiary Leaf-cutting Bee.

Although fossil remains furnish us with abundant evidence of the antiquity of many structural characters in animals, and permit us to surmise a like antiquity of certain habits, it is not often that we find preserved the proofs of the latter. The leaf herewith figured, collected in the Miocene shales of Florissant, Colorado, by two of my students, Messrs. Duce and Rusk, shows the work of a leaf-cutting bee. Evidently the specialised and peculiar habit of cutting out pieces of leaf to use in forming the nest was as highly developed, perhaps, a million years ago as it is to-day. The bee itself has also been obtained, and described as *Megachile praedicta*, Ckll., 1908.

T. D. A. Cockerell.

University of Colorado, January.

Tests for Colour-blindness.

With reference to the article on colour-blindness in Nature of January 27, I should like to point out that advocates of the Holmgren test assume that a person who fails with the wools will fail with coloured lights, and that a person who appears normal when examined with the wools is normal when examined with coloured lights. This was the first point which I proposed to settle when I took up the subject of colour-blindness. I found many varieties of colour-blindness, unimportant from a practical point of view, that failed, and many dangerous varieties of colour-blindness that passed this test. Many absolutely normal-sighted persons are also rejected by the Holmgren test; Germany has officially discarded it for this reason. Within the last fortnight I have examined two dangerous varieties of colour-blindness that passed the Holmgren test with the greatest ease; in fact, the most punctilious examiner would not have suspected that there was anything wrong with their colour sense, but both made the grossest errors with my lantern. The first case could not tell between the white, green, and red lights on trams at a distance of about one hundred yards.

The two factors which seem to be generally overlooked are the great effect of diminishing the intensity of a light in certain cases and the importance of taking into account the size of the image on the retina, that is to say, the number of cones stimulated. A few days ago I examined a normal-sighted man who had failed with the Holmgren test. He put definite browns with the green skein. When I found that he was normal I asked him to name the wools, and he did so correctly. I then asked him why he put browns with green. He replied, "I have been told I am green-blind, and I thought that there was green in those browns which I could not see." When I told him he was quite normal he had not the least difficulty with the test.
F. W. Edridge-Green.

Hendon, January 31.

Observations of Halley's Comet.

Readers of Nature may perhaps be interested to know that Halley's comet can now be seen with a good pair of field-glasses. Careful estimates make it almost exactly equal to an eighth-magnitude star.

The best form of instrument is a high-power Galilean binocular, and though the comet does not present any interesting features with such small optical aid, it can be distinctly seen, and distinguished from a star by its nebulous appearance. It is, of course, necessary to know the comet's position fairly exactly before attempting to pick it up. The following are a few of my notes:—

1910, Jan. 8, 12 and 13, Comet faintly seen in 1-inch finder Mag. ± 9·0.
,, ,, 15d. 8h. 45m. Faintly seen in binocular.
,, ,, 30d. 8h. 0m. Steadily seen in binocular.
,, Feb. 3d. 8h. 0m. Found with binocular, eighth magnitude (estimate 8·1).

P. M. Ryves.

Zaragoza, Spain, February 5.

Records of the Earthquake of January 22.

Dr. Chree has noted in Nature of February 3 the mechanical effect upon the Kew declination-magnetograph by the earthquake of January 22. Any confirmation of movements of this kind is of considerable value, and I therefore send you this notice of the corresponding effects upon the Stonyhurst magnetographs. All the three elements were markedly affected; the declination magnet was set in oscillation at 8h. 56m. a.m. for five minutes, the vertical force magnet also at 8.56 for about two minutes, and the horizontal force magnet was the most disturbed, commencing at 8.52 and lasting for quite ten minutes, with a maximum displacement of 3·5 mm. against the force of the torsion balance, but it is not clear that there was any swing on the opposite side of the normal position.

The origin of the earthquake remains apparently unknown, but, judging by our Milne seismograph, it was much nearer to us than any of the thirty earthquakes registered here since the instrument was fairly started on active service on July 1, and the proximity may account for the much greater swing of the boom. From the beginning I have claimed the eastern border of the Atlantic for the true region.

Prof. Milne's seismographs at Shide have shown an enduring displacement which has not been produced here.
Walter Sidgreaves.

Stonyhurst College Observatory, February 5.

The Mendel Journal.

In Nature for December 30, 1909 (p. 252), there appeared a review of the first number of the *Mendel Journal*, by "E. H. J. S." He also, in the same review, reviewed the current issue of *Biometrika*. I pass no comment upon the questionable fairness of having two such diametrically opposed journals reviewed by the same person, who, if we may judge by certain statements in the review, is himself a biometrician, or very friendly disposed towards them. I am alone concerned in dealing with your reviewer's misinterpretation and imperfect reading of certain articles of mine written under the *nom de plume* of "Ardent Mendelian." He accuses me of "adopting a tone calculated to be offensive to biometricians," and as an instance he cites the following sentence:—"We may further infer, therefore, that the discipline of the army[1] is very severe, and perhaps this may throw some light upon the constant reappearance of the figure 0·5 in relation to the size of some of its artillery equipment."[2] Your reviewer interprets this as a "serious charge of faking" directed against biometricians. I do not know upon what plan he writes his reviews or whether he reads sufficient of the article he reviews to grasp properly its tone and meaning. Nothing was farther from my intention than to impute want of integrity to any biometrician, notwithstanding some bad examples which they themselves have set, when they deal with Mendelians. Had your reviewer but read a few lines lower down (p. 160) he would have found the following chivalrous sentence, describing them:—

"In some respects it is a very fine army, and it is certainly an imposing one upon parade. It is led, officered and manned by men of transcendent intellect, of whom any country may be proud." And again, on p. 185, in commenting upon Dr. Raymond Pearl's work, I wrote:—"Could we assent to his methods we might commend his results; we can admire his skill as a workman, while lamenting his tools." Then on p. 164, where I criticised the particular way in which Prof. Karl Pearson had set certain questions to a correspondent, I wrote:—"We do not, of course, for one moment suggest that Prof. Pearson desires to be unfair, or that the nature of the question has in the smallest degree influenced the answer. We accept the evidence quite unreservedly."

These quotations are sufficient to show that the articles written by "Ardent Mendelian" were couched in the most courteous tones, and contained even chivalrous acknowledgments of the high ability and integrity of those whose methods of investigation and conclusions he felt bound to criticise. None but the most tender conscience could have misconstrued the particular sentence complained of into a charge of "faking" when the context of the article was taken into account; for how could "any country be proud" of men who "faked"? Your reviewer either could not have read any more of the article than the sentence he quoted, or he must have approached his work in a peculiarly prejudiced frame of mind. I do protest against the unfairness of such treatment. When a writer has been deliberately careful to adopt a courteous tone, it is not fairness to disregard his context—to quote a particular sentence and then to misconstrue it.

This sentence was never intended to convey a charge of "faking," and it simply alluded to the biometrical method of definition in constituting a sort of guide when dealing with investigations in certain problems. Had I intended to impeach the probity of any biometrician my language would have been unmistakable. If your reviewer had but recalled to mind the earlier works of biometricians, he would have remembered a generalisation called "homotyposis," and he would have further recalled that the homotypic average of correlation turned round the figure 0·5. He would also have remembered that this figure was reached by a remarkable process of excluding the parts or organs which were either "too like" or "too different," and this process was based upon an attempted definition by Prof. Pearson—who in my article is alluded to as the Field Marshal—in which he hoped to define the differences between variation and differentiation. This correlation figure of 0·5 was therefore reached by the exclusion of all parts or organs which would otherwise naturally tend to raise or lower the figure, and it was to this process of working by definition and exclusion, as defined by the "Field Marshal" that I alluded when I wrote the sentence which has been, I cannot but help thinking, carelessly misconstrued.

In conclusion, I can only ask that your readers will read the articles and judge for themselves of their courteous tone and fair treatment.

"ARDENT MENDELIAN."

"ARDENT MENDELIAN" is correct in supposing that I am a biometrician; but I am, at the same time, a believer in Mendelism, and I hold that the main aims of the *Mendel Journal* and *Biometrika* are not opposed. To me it appears that people who are studying the same problem by different methods should work in sympathy with one another, and it is for just this reason that I criticised the tone of "Ardent Mendelian," as I was of opinion that it was calculated to make such sympathy difficult.

With regard to the sentence beginning "We may further infer," I still maintain that my interpretation was the most natural one, even after making every allowance for the context; but I accept with the greatest pleasure the author's correction.

E. H. J. S.

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[1] Biometrical.

[2] It should be mentioned that the article was advisedly written in terms of martial imagery.

THE INTERPRETATION OF TOPOGRAPHIC MAPS.[1]

THE evolution of maps, and of our ideas regarding their use and function, might be made the subject of an interesting and profitable study. The main object of the early cartographers was to plot down with all attainable accuracy the relative size and position of countries, of towns or of smaller units, and to indicate such natural features as mountains and rivers; roads were added later, and, as the necessity became more evident and geodetic methods improved, the scale was enlarged, while the increasing accuracy permitted additional and minuter details to be introduced. The organisation of national cadastral surveys gave us at last the large-scale contoured maps that, with or without orographic colouring, constitute the highest expression of the map-maker's science.

Upon the basis of the topographic maps, special features of distribution and of activities, such as direction of winds and currents, may be shown, and lines of equivalent development of artificial and natural phenomena, such as isobars and all the other "isos," may find expression. Of these the topographic map takes no account; there has, however, with progress of geographical and geological methods, come a new way of looking at and interpreting a topographic map, so that it is made to disclose not only much that is hidden from the ordinary user, but even more than was recognised by the surveyor who made it. The old reading of a map was an appreciation of the morphology of a piece of country regarded as a statical phenomenon, without reference to either its internal anatomy, its physiology, or the mode and causes of its development; it asked for no reason. The new method seeks dynamical interpretations of all geographical phenomena, and asks how, and why, things are as they are.

A range of hills is no longer simply an elevated tract of country, delineated upon a map by certain contour lines, but it becomes the expression of facts of structure produced in a particular way, out of materials of a particular kind, by agencies the nature of which can often be inferred directly from the data supplied by the topographic map itself. In like manner, the history of a river-system, the development and interactions of its parts, and the climatic vicissitudes that have affected its drainage basin can be deduced from the map by the familiar exegetical device of reading the spirit of the commentator into the text. The department of geographical study, seeking among other objects the cultivation of this faculty, though deriving much of its initial impulse from the suggestion of British workers, from Hutton and Playfair to Ramsay, Jukes, Geikie, Jukes-Browne, and Marr, has been organised and placed upon a systematic basis, principally by the labours of workers like Penck and Bruckner on the Continent, and the host of American geomorphologists, foremost amongst whom must be placed Davis, Salisbury, and Shaler.

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[1] "The Interpretation of Topographic Maps." By R. D. Salisbury and W. W. Attwood. Pp. 84+cxx plates. Department of the Interior, U.S. Geological Survey, Professional Paper, 60. (Washington: Government Printing Office, 1909.)

In the magnificently illustrated volume before us, Prof. Salisbury and Mr. Attwood have attempted to show how a topographic map may be made to yield up all its secrets. The first section of the preliminary letterpress is substantially that which appears in the explanation of each fasciculus or folio of the geologic map of the United States. It sets forth the nature of the features delineated in the three categories of (1) water (blue), (2) relief (brown), and (3) culture (black). The last term might easily be misunderstood by a British reader—it does not refer to cultivation only, but to all the signs of man's handiwork, such as roads, railways, buildings, boundaries, that appear upon the maps. The geological details are, of course, expressed by the conventional signs and colours adopted by the national service.

The succeeding sections deal with elementary concepts of relief, followed by a succinct discussion of the various agents of change and their effects, under the headings wind, stream-erosion, alluviation; topographic forms resulting from unequal hardness of rocks, erosion cycles, stream piracy and adjustment, topographic effects of ground-water, glaciation, coastlines, volcanism, faults, special types of lakes. Each of these subjects is illustrated by one or more maps, mostly on the scale of about one inch to the mile (1/62,500 instead of 1/63,360), of actual pieces of country, and in most cases by pictorial illustrations.

The maps are beyond all praise for the beauty of their execution and the admirable printing; indeed, the contrast between the splendid series of maps of which these are specimens selected merely because they portray typical features of topography, and our British maps, inferior in delicacy, heterogeneous in style, badly printed on poor paper, is very humiliating to our national pride. The contour lines are beautifully engraved, and are drawn at intervals of 20 feet, whereas the 1-inch maps of the British Isles, with the exception of a portion of a single sheet, that embracing Longridge Fell in Lancashire, have contour-intervals of 100 feet, and even our 6-inch maps are contoured only at the same intervals, saving those of the fortunate counties of Lancashire and Yorkshire, the surveys of which had been accomplished prior to 1858, when the depreciation of our maps was decreed.

A Tidal Lagoon formed by sand spit at the mouth of San Luis Obispo Creek, California.

If any adverse criticism were offered of this admirable manual it would be that the landscape illustrations do not in all cases represent the area or even the district shown upon the map, though illustrating similar phenomena, or, where the area is the same, the point of view cannot be identified. These are small defects in a work that cannot fail to be of the utmost value to students and teachers the world over, and particularly to those of America, for whom it is designed, and those of Britain, who may have a century or two to wait for the materials out of which a similar memoir could be prepared for our own country.

P. F. K.

THE OXFORD UNIVERSITY MUSEUM.[1]

FEW [illegible] [illegible] to the pursuit of science [illegible] more interesting history or a more distinct individuality than the Oxford University Museum. It is the resultant of many of the most characteristic activities, and embodies some of the most earnest aspirations of the latter half of the nineteenth century. The two chief lines of scientific and artistic effort which converged upon Benjamin Woodward's Gothic pile found their most typical exponents in Acland and Ruskin; each of them a genuine enthusiast, each with not a few of the faults of his qualities, and each destined to witness the realisation of some of his ideals and the failure of others in the fabric which forms an appropriate monument of their lifelong association.

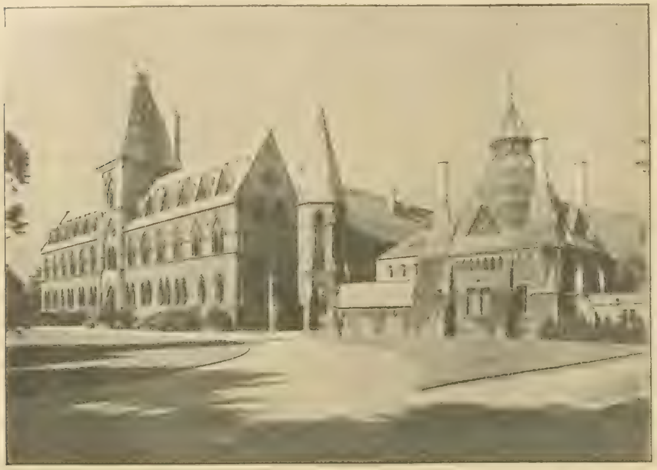

FIG. 1.—The Oxford Museum from the south-west. From "A History of the Oxford Museum."

The newer buildings which at the present day are grouping themselves around the central structure of the museum constitute with it an apt symbol of the manner in which the university has responded to the needs of scientific research and education in modern times. Oxford can never forget that she inherits a great tradition—literary and artistic, as well as philosophical. When first aroused to a sense of her responsibility in view of modern scientific demands, her main endeavour was to graft the new upon the old. No visitor to the original part of the museum can fail to recognise the outcome of this spirit in the structure itself, which is Gothic both in conception and in detail, in the blend of the conventional and the realistic in its scheme of decoration, and in the array of statues which, forming an integral part of the design, carry the mind of the observer from Hunter and Harvey back through the ages to Hippocrates and Aristotle. But the outlook of the University is to the future as well as to the past, and in the various annexes which have sprung up around the original building we see evidence of a desire to "let the dead bury their dead," and to enter frankly upon the task of meeting modern requirements with a single eye to practical efficiency. Still, whatever scientific developments may yet be in store, the Museum Court will, we may hope, always remain to testify to the fact that the future will be none the worse for having some of its roots in the past. It must be confessed that the organisation of scientific study in the university has hardly kept pace with the growth of scientific appliances. There is still too much clinging to respectable but antiquated methods in the system of college tuition, and, above all, in that of examinations. A promising field of university reform lies open in this direction.

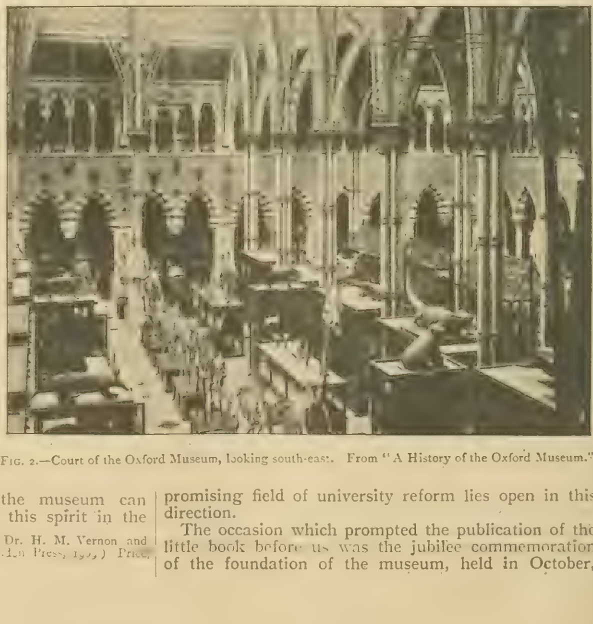

FIG. 2.—Court of the Oxford Museum, looking south-east. From "A History of the Oxford Museum."

The occasion which prompted the publication of the little book before us was the jubilee commemoration of the foundation of the museum, held in October,

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[1] "A History of the Oxford Museum." By Dr. H. M. Vernon and K. [illegible] Vernon. Pp. [illegible]. (Oxford, Clarendon Press, [illegible].) Price, 1s. [illegible].

1908. Dr. and Mrs. Vernon have succeeded in presenting an admirable account of the progress of science in Oxford from the days when Willis, Bathurst, Seth Ward, and Robert Boyle held their meetings at the lodging of Wilkins, Warden of Wadham, in which college Sydenham and Wren were at that time undergraduates. The history of the struggles and ultimate success of the little band who, led by Acland, Daubeny, and Walker, with help from Pusey, resolved that, so far as in them lay, science should take its proper place among the activities of Oxford, is carefully and sympathetically recorded. The work of the museum during the fifty years of its existence—work associated with the names of Phillips, Brodie, Prestwich, Rolleston, Moseley, Lankester, and Burdon-Sanderson, to mention only a few—forms the subject of a specially interesting chapter; and the book ends with an account of the jubilee commemoration itself. We wish that the authors had found space to include in their record the address delivered on that occasion by Dr. Vernon Harcourt—an address justly characterised by them as "most instructive and entertaining." Extracts, however, are incorporated in the body of the work.

The book is attractively got up, and illustrated with some good photographic plates, in the legends of two of which, unfortunately, the points of the compass are incorrectly given. We reproduce views of the exterior and part of the interior of the original building.

F. A. D.

THE DISTRIBUTION OF FRESH-WATER EELS.[1]

It is certain that the hydrographers of the *Challenger* and other deep-sea expeditions made their physical observations in the Atlantic Ocean depths all unsuspecting of the fact that thereby they were essentially helping to make an important contribution to the natural history of the fresh-water eel. Yet this fact constitutes part of the interesting information derived from a perusal of Dr. Schmidt's latest publication, a continuation of his previous famous researches upon the eel which have previously been described in the pages of NATURE.

In spite of the abundance and wide distribution of the genus Anguilla, the first and final chapters of its life-history were, until quite recently, matters of profound obscurity. It is a fact of common observation and knowledge that the elvers or glass-eels which in the spring months ascend our rivers frequently in countless numbers develop into young eels, and also that adult eels in their silvery breeding dress descend to salt water in autumn; but there, until a few years ago, knowledge ended and conjecture began. It was a common belief in this country that estuaries and harbours probably afforded the spawning places. In 1893 the Italian zoologists Grassi and Calandruccio proved that *Leptocephalus brevirostris,* a deep-water fish of obscure systematic position taken in the Mediterranean, was really a larval stage of the common eel. Dr. Schmidt and his Danish colleagues, whose energies were first directed upon this particular research because of the economic importance of the eel-fishery in their country, traced the early "elver" stage down to the open sea, and at last, by their deep-water investigations in 1904–5, succeeded in locating an important breeding region off the west coasts of the British Isles at depths of more than 1000 metres. Subsequent trawlings have revealed the distribution of the early (Leptocephalus) larval stage in the Atlantic Ocean from the Færoë Islands to Gibraltar, but always in water of more than 1000 metres depth and not less than 7° temperature. From these investigations, Dr. Schmidt came to the conclusion that "in order to propagate, this species demands certain external conditions (chiefly great depths with high temperature and salinity of water)," and it was to test the validity of this conclusion for other parts of the world that the research upon the geographical distribution of the fresh-water eel was commenced.

The Anguilla genus is widely distributed, being found in the Atlantic as well as in the Indian and Pacific regions. However, the main point of this inquiry will be best indicated by limiting our consideration to the regions of America, Europe and Africa where most data are available, and where (if we except eastern Africa) the question is simplified by being confined to two species only, viz. *Anguilla vulgaris,* the European species, and *A. chrysypa,* the American form. Now fresh-water eels are entirely lacking on the Pacific shores of North and South America (and of course in the river systems which have their outlet on this coast). On the Atlantic side, however, they are abundantly represented in the easternmost parts of Canada and the United States, and are found from southernmost Greenland and Labrador to the West Indian Archipelago and Guiana. On the other hand, they are lacking in South America south of Guiana, no single record, for example, occurring of the presence of fresh-water eels in the large river systems of Brazil and Argentina. They are found on practically all the islands of the Atlantic north of the Equator (Bermudas, Azores, Madeira, Canaries, Iceland, &c.), and, what is especially worthy of attention, they occur on islands where other fresh-water fishes are completely lacking. On the eastern side of the Atlantic they are found from the region of North Cape and southwards along all the coast of Europe, on all coasts of the Mediterranean, and on the north-western part of the coast of Africa. In Senegal they disappear, and are absent from all the rest of the west coast of Africa as far as Cape Colony, where the Indian Ocean species begin to be met with.

Thus in tropical, temperate, and even Arctic regions, Atlantic fresh-water eels are found—truly a wide-spread habitat, and one affording extremely varied environments! But it is on account of "this astonishing power to submit to most varied outer conditions" that their absence from certain regions is apparently incomprehensible. Why, for example, have they not been able to penetrate further southwards along the coasts of the Atlantic? In order to understand this, it is necessary to recall some of the results of later years' marine biological investigations, especially "the ascertained fact that very often the sensitiveness of a species of fish to its surroundings differs a great deal in its growth-period and in its spawning-time, so that during the latter its requirements as regards the outer conditions (depth, temperature, salinity) are much more definite and very different from those during the first, the effect of which is that the distribution during spawning-time may often be very different from that during growth. . . . It is in the first instance the requirements as regards the outer conditions during spawning time which influence the distribution."

The earlier investigations upon the spawning places of the eel have shown that in order to be able to propagate, the European fresh-water eel requires great depth (at least 1000 metres), a high salinity (more than 35·2 per cent.) and temperature (more than 7° C.) at this depth; and this is where the importance of the hydrographical data obtained from the temperature curves of the *Challenger, Valdivia,* and other deep-sea expeditions comes in. It is shown that "the absence of eels in all the large fresh-water systems of South America, western North America, and West Africa is due to the fact that the temperature in the deeper layers of the adjacent seas is too low to admit of the propagation." Incidentally, an explanation is afforded of the hitherto puzzling lack of success which attended the transplantation of eels from the eastern to the Pacific States by the U.S.A. Fish Commission in 1874 and other years. The eels themselves flourished in their new surroundings, but the Pacific Ocean afforded no place for successful reproduction.

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[1] On the Distribution of the Fresh-water Eels (Anguilla) throughout the World. (1) Atlantic Ocean and Adjacent Regions. A Biogeographical Investigation. By Johs Schmidt. With one chart. Pp. 45. (Copenhagen, 1909.)

Oceanic hydrography has thus supplied the indispensable key to the elucidation of a point in the biology of a species which is universally regarded as a fresh-water form. More strictly, however, *Anguilla vulgaris* may be considered as an oceanic species which has acquired the habit of migrating to fresh water for food and protection.

After all, the most interesting feature of this work is that it deals with an extreme case of the problem of the relationship between physical environment and fish propagation, a most important question in connection with the economic aspect of the fish supply. Dr. Schmidt has contributed pioneer work of great value towards the understanding of these phenomena in regard to other species besides the eel. We may mention, for example, his research upon the plaice and cod in Icelandic waters, where he has shown by marking experiments that a regular spawning migration takes place into the warmer Atlantic water off the south and south-west of the island. Here again the phenomena are clear and comprehensible, because they are, as it were, "writ large"—the difference in temperature between the cold water off the north and east and the warmer Atlantic waters off the south and west of the island being very marked, which renders the migration practically an absolute necessity for the survival of the offspring. Essentially the same in principle are the problems of correlated physics and biology in British seas which still, to a great extent, await elucidation. But here the phenomena are not "writ large"; on the other hand, they can only be demonstrated by the study of observations made with fine precision and extended over a considerable period of time. A. E. H.

THE PARIS FLOODS.

IT is now an evident fact that Paris has recently suffered the ravages of an inundation greater and more severe than any which have visited the city within the last two and a half centuries. A gauge at the bridge of La Tournelle shows the surface of the water as having reached a height above the bed of the river of 27 feet 10½ inches. Normally, it is only about 8 or 9 feet, and it is necessary to go back so far as the year 1658 in order to find any record exceeding, or even approaching, this figure. At that date the height attained was 28 feet 10½ inches. A few years previously (1651) there was a flood of 25 feet 8 inches, and in 1649 another of 25 feet 2 inches. The flood of 1802, great as it was, did not exceed 24 feet 5 inches, and that of 1876 only reached 21 feet 11 inches.

The known records are as follows:—

		ft.	in.
February	1649	25	1½
January	1651	25	8
February	1658	28	10½
February	1690	24	9
March	1711	25	0
December	1740	25	11
February	1764	24	0½
January	1802	24	5
March	1807	22	0
January	1910	27	10½

The causes of the flood are not quite so obvious as the effects. At first sight it would appear that there is no very satisfactory explanation to be vouchsafed. In the watershed of the Seine and its tributaries there is an absence of lofty ranges with snow-capped summits, capable of producing copious liquidations such as prevail in mountainous regions. But on the other hand, there are numerous impermeable districts within the Seine Basin where the rainfall finds its way almost entirely into the river bed, and if to the effect of a prolonged precipitation in these areas there be added the far from negligible contribution of melted snow from the impermeable Morvan Plateaux, produced under the influence of a sudden and abnormal rise in temperature, we need not pursue inquiries very much further in order to arrive at an adequate solution of the problem.

The Seine at Paris is formed by the confluence of three important streams: the Yonne, the Upper Seine, and the Marne. Of these the Yonne is the only one presenting torrential characteristics; it rises rapidly, and subsides as quickly. The other two streams move more slowly, and change less abruptly. After a period of heavy rainfall the flood waters of the Yonne arrive first at the point of confluence, reaching it at the end of three or four days, and they produce the greater portion of the rise in level. Four or five days later the waters of the Upper Seine and Marne arrive, having been fed by filtrations through more permeable ground and by surfeited springs, and these simply serve to maintain the effect of the previous increment. If towards the end of this period the previous meteorological phenomena in the upper reaches repeat themselves, the effect produced is that of a single continuous flood of considerable intensity.

Fortunately, floods in the neighbourhood of Paris can be predicted sufficiently in advance to enable remedial, or at any rate palliative, measures to be undertaken. The Seine, as has been pointed out, rises but slowly, and the effects of floods in its affluents are visible several days beforehand, and can be announced accordingly. There is ample warning for the inhabitants to withdraw, if need be, from the threatened quarters. An empirical rule has even been established which enables the height attainable by the flood to be approximately stated. The rise of the Seine at Paris is just about double the mean of the partial rises in its affluents at certain fixed points. The hygrometric service of Paris, therefore, plays a very useful part in issuing these forecasts, and renders valuable service to the community at large.

PROF. F. PURSER.

THE news of the death of Prof. F. Purser, professor of natural philosophy in the University of Dublin, announced in last week's NATURE, has been received with deep regret. His life had just reached the regular period of seventy years, and intellectually he was as vigorous as ever.

Prof. Purser was one of the ablest and most brilliant members of a very clever family. His father managed Guinness's Brewery in the time of Sir Benjamin Guinness, and it was to a great extent owing to his skill, foresight, and enterprise that the brewery attained the colossal dimensions it possesses at present. His elder brother was a mathematician of a very high class, and was for several years professor in Queen's College, Belfast.

Two of his cousins were distinguished professors of the University of Dublin. One held the chair of institutes of medicine, or physiology; the other, Dr. Louis Purser, was professor of Latin, and is still public orator.

Prof. Purser's university career was very brilliant. He obtained a science scholarship in 1859, a large gold medal in mathematics, pure and applied, at the moderatorship examination in 1860; Bishop Law's mathematical prize, the MacCullagh prize, and in 1872 fellowship. At that time the fellows of Trinity College, Dublin, were supposed to be members of what had recently been the Established Church, and on their election were obliged to make a declaration which was partly of a religious character. Frederick Purser was a Moravian, and though no question would have been asked as to his special form of belief, he considered that he could not with truth make the required declaration, and consequently the fellowship he had won was declared vacant.

In 1873 Fawcett's Act abolished religious tests in the University of Dublin, and Purser began to read again for fellowship, which he gained for the second time in 1879. This has always been regarded as a wonderful feat by those who are best acquainted with the nature and difficulty of the fellowship examination in Trinity College. In 1902 Purser succeeded Tarleton as professor of natural philosophy, which professorship he held until his death. In 1905 and 1906 he was a vice-president of the Royal Irish Academy. He published in the Proceedings of the Academy some fine papers on the applications of Bessel's function to various difficult questions in physics. Some beautiful investigations of Prof. Purser are to be found in Tarleton's "Introduction to the Mathematical Theory of Attraction." Purser's publications, however, represent most inadequately the extent of his knowledge and his genius.

A more profound or accurate thinker than Prof. Purser it would be difficult to find. He was not merely a mathematician—he was also a metaphysician of the highest order. His paper, published many years ago in *Hermathena*, on "Hamilton's System of Natural Realism," was a work of rare ability. In that paper he showed that Hamilton's theory, when stripped of its absurdities and inconsistencies, was almost the same as the theory of Kant. As a metaphysician Prof. Purser was in the main a follower of Kant. Of geometrics of space of more than three dimensions he had a poor opinion, and looked upon them as little more than algebraical exercises.

Possessed of considerable wealth, he expended it with the greatest generosity. He was a munificent benefactor of Queen's College, Belfast, where his brother was a professor; of Trinity College, Dublin; and of the Royal Irish Academy.

Prof. Purser's chief fault—if it may be described as such—was one which appears to belong to the whole Purser family, that is, the fault of thinking far too little of his own powers and of the value of his own performances.

NOTES.

For the meeting of the British Association for the Advancement of Science, which is to take place this year at Sheffield on August 31 and following days, under the presidency of Prof. T. G. Bonney, F.R.S., the following presidents have been appointed to the various sections:—A (Mathematical and Physical Science), Dr. E. W. Hobson, F.R.S.; B (Chemistry), Mr. J. E. Stead, F.R.S.; C (Geology), Prof. A. P. Coleman; D (Zoology), Prof. G. C. Bourne; E (Geography), Dr. A. J. Herbertson; F (Economic Science and Statistics), Sir H. Llewellyn Smith, K.C.B.; G (Engineering), Prof. W. E. Dalby; H (Anthropology), Mr. W. Crooke; I (Physiology), Prof. A. B. Macallum, F.R.S.; K (Botany), Prof. J. W. H. Trail, F.R.S.; L (Educational Science), Principal H. A. Miers, F.R.S.

In a speech delivered at Washington last week, Commander Robert E. Peary proposed, on behalf of the Peary Arctic Club, that the National Geographic Society should unite with the club in the organisation of a United States South Polar Expedition, to start in the autumn of this year. He promised that the Peary Club would lend the *Roosevelt* for the purposes of the expedition, but stated that he himself would be unable to assume the command in person. The proposal has since been accepted by the directors of the National Geographic Society. All proposals which aim at the extension of knowledge of the Antarctic area are to be welcomed, but now that so many projects for the exploration of the south polar regions are to the fore, it is necessary to consider how Commander Peary's scheme stands in relation to other Antarctic enterprises. The only expedition at present in the field is that under Dr. Jean Charcot on board the *Pourquoi Pas*, which a year ago penetrated the Antarctic regions to the south of South America. It intended to make its way westwards, and, if possible, undertake a "dash" to the South Pole from the ship's winter quarters. If the expedition makes its way northwards again this season, news of it should be received in the course of the next two months. The British expedition now in course of organisation by Captain Scott will make its headquarters in McMurdo Sound, and, if possible, land a small party on King Edward VII. Land. The expedition proposed by Commander Peary will not interfere with these plans in any way, since it is suggested that its base should be on the opposite side of the Antarctic continent, that is to say, on Coats Land, in the Weddell Sea, south of the Atlantic Ocean. This is the coast which Dr. W. S. Bruce, its discoverer, wishes to make the base of a Scottish Antarctic expedition, and Sir Ernest Shackleton has also stated that if he should go south again he would probably attempt to reach the Pole from the side of the Weddell Sea. An alternative base suggested by Sir Ernest Shackleton is Gaussberg, to the south of the Indian Ocean, off which the German expedition under Dr. Von Drygalski wintered in 1902. Gaussberg is situated on the Antarctic circle; the most southerly known point of Coats Land is just beyond the seventy-fourth parallel, or 960 geographical miles from the Pole, while Cape Royds, in McMurdo Sound, where Captain Scott proposes to winter, is in between 77° and 78° south latitude, nearly 750 geographical miles from the Pole.

Mr. W. Bateson, F.R.S., and Dr. H. T. Bovey, F.R.S., have been elected members of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

The Julius Thomsen memorial lecture of the Chemical Society will be delivered on February 17 by Sir Edward Thorpe, C.B., F.R.S.

Four lectures on "The Anatomy and Relationships of the Negro and Negroid Races" will be delivered in the theatre of the Royal College of Surgeons, Lincoln's Inn Fields, by Prof. Arthur Keith (conservator of the museum), on February 14, 16, 18, and 21. Ladies and gentlemen will be admitted to the lectures on presenting their private visiting cards.

The annual conversazione of the Selborne Society will be held on Friday, February 18. An address will be given by Sir John Cockburn, K.C.M.G., and a lecture on "Selborne and its Associations with Gilbert White" by Mr. E. J. Bedford. There will be a large display of exhibits under the microscope, as well as exhibits of natural-history specimens, nature photographs, and other objects of scientific interest.

Sir Patrick Manson has been elected a correspondant of the Paris Academy of Sciences in succession to the late Sir Burdon Sanderson.

According to a Reuter telegram from Berlin, published in the *Times* of February 3, the expedition dispatched to German East Africa to collect dinosaurian remains is proving successful. A femur, measuring 6 feet 10 inches, is specially mentioned, on account of being nearly 2 feet longer than the corresponding bone of the Carnegie Diplodocus.

The King has presented to the natural history branch of the British Museum the skeleton of his famous thoroughbred "Persimmon," which has been set up by Rowland Ward, Ltd., Piccadilly. This is the first complete skeleton of a thoroughbred to be exhibited in the museum, the skeleton of "Stockwell," which is also contained in the collection, being represented in the exhibited series merely by the skull and the limbs of one side. In common with most or all thoroughbreds with the blood of "King Tom" in their veins, "Persimmon" exhibits a trace of the sinuous skull-profile characteristic of Arabs. The museum previously possessed a statuette of "Persimmon," presented in 1905 by H.R.H. the Prince of Wales.

The first ordinary meeting of a new society, formed by the amalgamation of the Society of Engineers and the Civil and Mechanical Engineers' Society, was held on Monday, February 7, at Caxton Hall, Westminster. Mr. Diogo A. Symons, the first president of the new Society of Engineers, delivered an inaugural address. Referring to the examination which is to be the qualification for fellowship of the society, he believes that its introduction will have the same beneficial effect as has been the case in the Institution of Civil Engineers. Proceeding to more general subjects, he directed attention to the value of workshop training to engineering students, whether they intend to take up the civil or the mechanical branch of the profession. Speaking of the education of young engineers, Mr. Symons emphasised the importance of a thorough grounding in fundamental principles before any attempt at specialisation is attempted, and laid stress on the advantage of gaining engineering experience with a contractor on public works. The tendency of engineering students to accept salaried appointments after too brief a training was deprecated, because such appointments usually involve loss of valuable instruction and experience.

According to the *Pioneer Mail* of Allahabad, a preliminary astronomical conference was held recently at Papanasanum, and another will be held later at Kaladi (Travancore Native State). Astronomers from all parts of India, representing the three different schools of astronomy, viz. Siddhanatha, Vakya, and Drigganitha, are being invited. It is also proposed to give a prize of not less than Rs. 100 (one hundred) to each of these different schools of astronomy; but if Pundits from distant parts cannot come to the conference, they may send written papers in Sanskrit or English. The objects of the conferences are to check the irregularities in calculations now found in the Indian Almanac, and to arrive at some satisfactory solution with reference to the system of calculation to be adopted in the making of future almanacs.

The second Congrès International du Froid will be held at Vienna on October 6–12, before the close of the International Sporting Exhibition, and the University has been lent for the meetings. Briefly, the subjects to be discussed are the science of cold; the industrial production of cold; the application of cold to alimentation and to other industries; transport; and legislation. The Archduke Leopold Salvator, at the request of the Emperor of Austria, is acting as patron of the congress, and receptions will be given to the delegates by the Court and by the towns of Vienna, Budapest, &c. Papers must be submitted to the Association International du Froid through the British committee. Full particulars of the congress may be obtained from Mr. R. M. Leonard, honorary secretary for the United Kingdom, 3 Oxford Court, Cannon Street, London, E.C.

The scientific expedition dispatched to Dutch New Guinea by the members of the British Ornithologists' Union has sustained a great loss by the death of Mr. Wilfred Stalker, one of its most skilled naturalists. At the present time no details are known beyond the melancholy fact that he was drowned on January 9. The news was received by telegram from Batavia on February 1, and had probably been forwarded by steamer from the Aru Islands. With this telegram Mr. Ogilvie-Grant received a long letter from Mr. Stalker, written from "Amboina, December 24, 1909." In this he stated that he had been successful in engaging the services of 150 carriers, and was expecting the arrival of Mr. Walter Goodfellow, the leader of the expedition, in a few days. He also mentioned the dispatch of various cases containing collections of mammals and birds, &c., which had been procured in Central Ceram, and are likely to prove of great interest. Mr. Stalker left England about a year ago, and proceeded to the Aru Islands to obtain living examples of birds of paradise for Sir William Ingram. It had been arranged that, after completing this engagement, he should join the other members of the British Ornithologists' Union expedition, filling up his time until their arrival by collecting natural-history specimens and in making the preliminary arrangements for transport in New Guinea. His letter, mentioned above, states how usefully he had employed his time in carrying out his instructions. Mr. Stalker had already had considerable experience of life in New Guinea, having spent several years (between 1904–6) at the gold mines on the Mambare River, in the northern part of the British territory. It was then that he first began to collect specimens for the Natural History Museum. Subsequently, at the suggestion of Mr. Oldfield Thomas, who had discovered his great ability in trapping and preparing mammals, he was sent by Sir William Ingram and the Hon. John Forest to Alexandra, in the northern territory of South Australia, and in 1907 to Inkerman, in East Queensland. In both these places he did admirable work, and formed fine collections of mammals, which were presented by his patrons to the Natural History Museum. In 1909, in company with Mr. C. R. Horsburgh, he again visited British New Guinea and the Aru Islands on behalf of Sir William Ingram, and was successful in bringing back a large number of living birds of paradise, including a male of the beautiful blue bird of paradise (*Paradisornis rudolphi*), which had not previously been brought to Europe alive. Early in 1909, after a short stay in England, he again started on the present undertaking, when he so unfortunately lost his life. Mr. Stalker was quite a young man—only thirty-one years of age—having been born on January 17, 1879, and it is sad to think that the successful career of this talented naturalist should have been terminated so early and in so tragic a manner.

Dr. C. C. Hoffeus, of Shöneberg, near Berlin, has favoured us with a copy of the *Leipziger Tageblatt* for

July 24, 1909, in which he recommends the alliaceous plant locally known as "knoblauch" (*Allium ursinum* and also *A. acutangulum*) as a table-vegetable. These plants grow abundantly at Rosenthal, where cabbages cannot easily be raised, and, when properly cooked, are stated to have a flavour superior to that of spinach, the garlicky odour entirely disappearing after a prolonged soaking in water and the application of salt.

THE Transactions and Proceedings of the Perthshire Society of Natural Science for 1908–9, vol. v., part i., contain the report of an address delivered in March last by the president, Mr. W. Barclay, on the proposal to re-afforest large areas in Scotland. The scheme is cordially approved in the address, and a resolution was carried at the meeting in support of the recommendation of the Royal Commission that a State forestry department should be established, with power to put the work in hand. The scheme, it was urged, would eventually prove a financial success, and would provide present employment.

No. 2 of section *b* of vol. xxviii. of the Proceedings of the Royal Irish Academy is devoted to a list of the Neuroptera of Ireland, by Messrs. J. J. F. X. King and J. N. Halbert. This catalogue, which is to replace one published more than twenty years ago by one of the present authors, it is hoped will form a standard of reference for future observations. Although our knowledge of the native dragon-flies, like that of the other Neuroptera, is far from complete, there is no doubt that Ireland possesses fewer of these insects than Great Britain. Twenty-five species were included in the Irish list of 1889, but the number must now be reduced to twenty-three. The study of the may-flies has been so neglected that there are few changes to record from the old list.

ANGLER-FISHES (Pediculati) and their habits form the subject of a richly illustrated paper by Dr. T. Gill, published in the Smithsonian Report for 1908. Nearly all the species inhabiting shallow or moderately deep water are provided with an angling apparatus—the "illicium"—which undoubtedly serves as a rod, line, and bait, although the action is probably automatic. Certain stoutly built members of the group are, however, denizens of deep water, and in these the fishing apparatus has been modified into a rod with a bulb furnished with a phosphorescent terminal portion, while the surrounding "bait" has likewise been specialised and augmented; and, in addition to all this, a lantern and worm-like lures are present. How efficient this apparatus must be will be apparent to all who have witnessed salmon-spearing by torchlight.

GREAT interest attaches to an article by Dr. R. S. Lull, in the January number of the *American Journal of Science*, on the distribution of dinosaurian reptiles. It should be premised that dinosaurian remains are unknown from Central and North-eastern Asia, which may be attributable either to our lack of knowledge of the palæontology of that area or to the circumstance that these reptiles never occurred there. The theropod group is believed to have originated in North America—"Laurentia"—whence they migrated in one direction, probably at a late epoch, into South America, and in another, by way of Greenland and Iceland, to Europe, and thence to India, Africa, Madagascar, and Australia. The Sauropoda, on the other hand, are regarded as an Old World group, migrating early in the Jurassic into the great southern continent of the Old World, "Gondwanaland," and also into the New World. In the southern hemisphere they had a distribution nearly as extensive as that of their carnivorous cousins, and survived long after they had disappeared from the north, occurring in India during some part of the Cretaceous, and in Patagonia—their last stronghold—during the Laramie, or topmost Cretaceous. On account of their semi-aquatic habits, they were independent of complete land-connections, and could thus extend their migrations across areas impassable to the strictly terrestrial Ornithopoda (Orthopoda), as typified by the iguanodon. This may be the reason why the latter group never succeeded, so far as our present information goes, in penetrating the southern hemisphere, although it is possible that the date of their radiation may have been later, when communication between Europe and Gondwanaland was interrupted; while it has also to be borne in mind that, judging from their dentition, they were dependent upon a particular kind of food. Originally the Ornithopoda were probably a North American group, and the horned, or ceratopsian, section appears to have been restricted to the western continent.

THE seventh volume of the *Journal of Experimental Zoology*, which was completed with the November (1909) number, contains no fewer than a dozen memoirs on regeneration in animals. Now that the study of this subject includes the effect of drugs upon the rate of regeneration, with the whole pharmacopœia on the one hand and the entire animal kingdom on the other from which to select material for experiment, there seems no reason why such researches should ever come to an end. Of course, the same may be said of almost any other branch of biological investigation, and, indeed, the rapid accumulation of literature at the present time threatens either to swamp biologists altogether or else to force them to take refuge in a very narrow specialisation.

THE problem of sex-determination continues to receive a very large share of attention from cytologists. One of the most notable recent contributions to the already extensive literature of the subject is a memoir, by Prof. T. H. Morgan, entitled "A Biological and Cytological Study of Sex Determination in Phylloxerans and Aphids," published in the *Journal of Experimental Zoology* for September, 1909 (vol. vii., No. 2). In addition to the author's own observations, this paper contains a critical review of the recent literature of the subject. The theory of accessory chromosomes and the Mendelian interpretation of sex are dealt with. It is admitted, however, that the problem has as yet by no means reached a satisfactory solution. Prof. Morgan regards the quantitative interpretation of sex-determination as only the first rough approximation to such a solution, and he thinks that the accessory chromosome may follow sex or be associated with other differences that determine sex rather than be its sole cause.

THE genus Œnothera has received world-wide attention from botanists since Prof. de Vries founded his mutation theory largely on the variations he obtained by cultivation of certain wild forms. In the hope that North American and European botanists may be induced to make a careful examination of other wild colonies, Mr. R. R. Gates, who has already investigated several of the variants, has compiled an analytical key to the principal segregates and mutants of the genus, which is published in the twentieth annual report of the Missouri Botanical Garden. Ten species and fourteen forms derived from *Œnothera Lamarckiana* are delimited.

THE consequences of cattle-grazing in Indian forests are discussed by Mr. J. W. Best in the *Indian Forester* (November, 1909), where he notes the results of his observations in a division of the Central Provinces. Grazing is restricted to definite areas where least harm can be done, and, as a rule, goats are prohibited entirely from reserved forests. The destruction of young trees is, of course, the chief danger, since it leads to uneven regeneration. A noticeable feature is the increased development of certain trees with protective devices, such as armed species of Gardenia and the thorny *Zizyphus Oenoplia*. The saplings of *Butea frondosa* also escape the ravages of the cattle; and since this tree is valuable for the cultivation of lac insects, it is recommended that it should be extensively grown on grazed areas.

SEVERAL facts of importance in connection with the development of monocotyledonous embryos are recorded by Mr. W. E. Evans in an account of the germination of Asparagus, Ruscus, and Polygonatum appearing in Notes from the Royal Botanic Garden, Edinburgh (August, 1909). In the case of Asparagus, the axis of the seedling soon breaks through the cotyledon sheath, although the first two internodes do not elongate, so that one or two small hypogeous scale leaves are found at the base. The buds in the axils of these leaves give rise to the first beginnings of the sympodial rhizome. The primary root thickens, and presents the appearance of a pull-root. The germination of Ruscus and Polygonatum seedlings is similar, but several basal scale leaves are formed, and in Polygonatum the hypocotyl takes part in the formation of the fleshy rhizome.

ON the island of St. Vincent cotton and arrowroot provide the most valuable agricultural export commodities, while cacao and sugar are of subsidiary but appreciable importance. The report for 1908–9 of the botanic station, published with the reports of other agricultural establishments, presents several interesting facts concerning these economic products. The Sea Island cotton, by reason of favourable soil and climate in the coastal districts where it is grown, has maintained its reputation as the best quality produced in the West Indies, and the quantity exported during the year has increased in amount; but lower prices and bad weather have caused a small decrease in the area planted and in the output. Arrowroot can be grown in all parts of the island, and the supply could be increased if fresh markets were obtainable. A feature of the cacao cultivation is the necessity for shade, for which purpose the leguminous tree *Gliricidia maculata* is utilised.

THE Department of Lands, New Zealand, has sent us a copy of the surveyor-general's report for the year 1908–9. The greater part of the report is occupied with an account of the progress of the different surveys, but some of the notes and appendices are of general interest. The Milne seismograph at Christchurch registered forty-six earthquakes, the average annual number during the preceding six years being eighty-two. The record of the Messina earthquake will prove of considerable interest, as Christchurch is not far from the antipodes of Calabria. A foundation has been laid for the measurement of secular movements of the New Zealand coasts in the determination of the mean sea-level at Auckland, Wellington, and four other ports, and its reference to permanent bench-marks on the adjoining shores. The Wellington Harbour gauge-charts exhibit many instances of very pronounced seiche-oscillations, much more so than at the other ports, and it is found that in most cases they are accompanied by a change of wind from north to south or *vice versâ*, the wind at the time being generally strong.

THE University of California has issued, as the fourth part of vol. vii. of its Proceedings, a report on the shell-mounds of the San Francisco Bay region, by Mr. N. C. Nelson. The environment of these shores favoured occupation by numerous fishing tribes, and no fewer than 425 mounds, some of considerable extent, have been mapped and described. The culture disclosed in these mounds is generally uniform and of the Neolithic type, rude stone implements being found only in inconsiderable numbers. These people buried their dead in the collections of shells and other débris in the neighbourhood of their dwellings, and a large collection of osteological remains has been made which still awaits examination. It seems probable that the builders of these mounds were of the same race as the present Indians of the neighbourhood, but it is at present impossible to fix the approximate date at which they may have been formed. They are certainly of considerable age, because some species of oysters and mussels the shells of which have been recognised in the mounds have disappeared from the locality. From calculations of the daily supply of fish required by the group of families occupying a single site, Mr. Nelson estimates that the accumulation of shells in one mound may have extended over 3500 years.

THE Bureau of Science of the Government of the Philippine Islands has published parts iv. and v. of vol. iv. of its Bulletin, dealing respectively with medical sciences and general science in respect to the Philippine Islands. The former of these two parts, compiled with the assistance of the staff of the Philippine Medical School, presents a very complete medical survey of the town of Taytay, showing the diseases prevalent in the community and the conditions under which it lives. "While the conditions of the town are generally unsanitary, the death-rate varying in different years from 27·91 per 1000 to 45·42 per 1000, they at times become most unsanitary. Under the present conditions epidemic diseases such as cholera, typhoid, and bacillary dysentery are likely to occur from time to time." Various recommendations in regard to vaccination and water supply are urged to remedy this state of unhealthiness. The part which deals with general science contains papers on geology, road-making materials, and anthropology. The anthropological contributions contain a vast number of measurements which must ultimately prove of great value to the ethnologist, despite the accompanying absurd classification of the inhabitants into Iberian, Cromagnon, Australoid, Alpine, Adriatic species, varieties, &c.

A MEMORANDUM on recent weather and on the probable character of that of January and February, 1910, in the Punjab and north-west frontier-province of India, published by the Director-General of Observatories, concludes that the total precipitation in that locality will probably reach or exceed the average in the latter months. This inference is chiefly based on the fact that during fifteen out of eighteen years since 1890–1 an excess or a defect in the rainfall in December has been maintained in the two following months. In December, 1909, the area in question had an excess of 1·4 inches over the normal amount. The Director-General states that another favourable sign is that the vertical gradients of barometric pressure were abnormally steep during December.

IN the *U.S. Monthly Weather Review* for June last, just received, Prof. A. G. McAdie refers to the interesting and somewhat important problem of the prevention of damage by frost in orchards, &c. He states that the great mass of experiments made in California orchards shows that direct heating of the air by open fires has not been sufficient to prevent injury at times of very low temperature, and quotes a recent experiment of a careful observer there during a night when the temperature ranged between

19° and 24°. Very large amounts of wood and wet hay were burned, but, the air being dry and calm, the smoke rose straight upwards, and although three large fires were maintained between 20 and 30 feet of a certain tree, the temperature in the vicinity of the tree remained for some hours about 20°. Prof. McAdie's conclusion is that a proper cover spread some feet above the surface is the most effective means of protection of plants. When necessary, this may be supplemented by the use of small stoves, &c., placed on the ground.

A NEW form of watch-glass clip has been submitted for inspection by Messrs. J. J. Griffin and Son, Ltd., of Kingsway, London. It consists of two small metal rods joined by steel spring wire to form a holder, of lenticular section, which can slide over a pair of watch-glasses having their edges in contact. When desired, it can also be used for a single glass. The hold is very firm, and the clip is easily affixed and detached; it is also lighter, neater, and less cumbersome than the older brass contrivances. Within limits, the same clip will serve for different sizes of glass; but two sizes of clip are recommended for ordinary use, namely, those taking glasses up to 1¾ inches and up to 2¾ inches in diameter respectively.

THE December (1909) number of the Journal of the Institution of Electrical Engineers contains a paper read before the institution in May last by the president, Mr. W. M. Mordey, on some tests of the Mansbridge paper condensers described in these columns a year ago, and of the Moscicki glass condenser, or engineering form of the Leyden jar. Mr. Mordey finds that the losses on alternating current circuits only amount to about 0·6 per cent. in the case of the Mansbridge and 1 per cent. in that of the Moscicki condenser, the former being tested up to 500 and the latter up to 10,000 volts. In these circumstances the author points out that the general introduction of condensers on alternating circuits to compensate for the lag of current due to inductive loads becomes a possibility of the near future.

THE agenda paper of the general meeting of the Société française de Physique on January 21 contains, in addition to the business items and *résumés* of the papers read at the last meeting, a balance sheet for the session 1908–9. From it we gather that the society now has about 1500 members, almost equally divided between Paris, the rest of France, and foreign countries. The subscriptions for the year amount to 600*l.*, and the society has 10,000*l.* invested in French railways. The cost of printing the quarterly *Bulletin des Séances*, a volume of 300–400 pages per annum, and the fortnightly agenda and *résumé* of papers read, is about 140*l.*, and the cost of distribution of these publications to the members amounts to 130*l.* We offer the society our congratulations on its strong position and on the excellent work it is doing.

THE reconstruction of the Tyne North Pier, which has just been completed, forms the subject of illustrated articles in *Engineering* and in the *Engineer* for January 28. The importance and difficulty of the work executed by the contractors, Messrs. Sir John Jackson, Ltd., under the direction of Sir John Wolfe Barry and Messrs. Coode, Son, and Matthews, may be understood from the fact that, in exceptional storms, waves 35 feet in height from trough to crest have been recorded at the mouth of the Tyne, and, owing to the deep water, are propagated almost so far as the pier itself. The old pier met its death-blow during the great gale of January, 1897, when 110 feet of the wall on the seaward side fell outwards. As reconstructed, the North Pier is 2900 feet long, and the entrance to the harbour is now 1180 feet wide. From the foundations on the shale, which was dressed level by divers, the pier has been built of concrete blocks, with granite facing on the outer courses. The depth of foundation below low water of spring tides varied from 28 feet to 44½ feet, being, on the average, about 20 feet more than in the old structure. The width at quay-level is 37 feet, and at low-water level 50 feet. Access is obtained during stormy weather to the lighthouse and machinery for blowing the fog signal at the pier-head through a tunnel, which is constructed under the promenade.

A DESCRIPTION is given in *Engineering* for January 28 of the system of photographic surveying from balloons devised by Captain Scheimpflug, of Vienna. The inventor's experiments have been going on for some years, and formed the subject of a lecture recently given by him before the Physical Society of Frankfort-on-Main. Briefly, the panorama camera consists of a central camera having a horizontal plate and seven inclined lateral cameras surrounding the former. The cameras are rigidly connected with one another, and the shutters are released simultaneously, so that a very large field is secured. Horizontal projections of the inclined negatives are produced by means of a special apparatus, when the resulting panorama views show a centre heptagon surrounded by seven other trapezoidal photographic sheets. The diameter of country represented will be about five times the height of the balloon and camera at the moment of exposure. Photographs are taken at rapid intervals while flying over the ground, and it is desirable that the resulting views overlap by more than half. The nadirs of successive photographs will then be discernible on the same plate. Heights can be obtained from the photographs by means of another apparatus—the zone transformer. The inventor estimates that a survey of German South-west Africa by his system could be accomplished in fifteen years at a cost of 2,000,000*l.*, as compared with a plane-table survey, which would occupy 150 years at an estimated cost of 10,000,000*l.* There certainly seems to be a field for photographic surveying from airships.

THREE new volumes, Nos. 6–8, have been added to the series of books on Egypt and Chaldæa published by Messrs. Kegan Paul, Trench, Trübner and Co., Ltd. They form a second edition, revised and enlarged, of part of Dr. Budge's work on the "Book of the Dead," published under the title of "The Chapters of Coming Forth by Day." The subtitle describes the volumes as an English translation of the chapters, hymns, &c., of the Theban rescension, with introduction, notes, &c. The first edition of Dr. Budge's work, of which the present translations formed the third volume, was reviewed at length in our issue for February 10, 1898 (vol. lvii., p. 337). The translation given in the present series is not merely a reprint from the original issue, for it has been carefully revised and compared with the original texts, and many brief explanatory notes have been added. More than four hundred vignettes, taken from the best papyri, have been reproduced in these volumes at the heads of the chapters, the general contents of which the ancient Egyptian scribes and artists intended them to illustrate. These translations form a representative collection of the various compositions which the Egyptians inscribed upon the walls of tombs and sarcophagi, coffins and funeral stelæ, papyri and amulets, in order to ensure the well-being of their dead in the world beyond the grave. The price of each of the present volumes is 5*s.* net.

The twelfth edition, revised, of Mr. W. T. Lynn's small volume on "Celestial Motions" has been published by Messrs. S. Bagster and Sons, Ltd., price 2*s.* net. The book is an easy introduction to the main facts of astronomical science, and the frequent re-issues enable the author to keep it up-to-date.

Mr. John Browning has issued the fourth edition, re-written and revised, of his concise little book "How to Work with the Spectroscope." The book provides beginners with a handy guide to the use of spectroscopes of various kinds, including McClean's star spectroscope, the microspectroscope, and others; and we welcome it as a simple means of extending the circle of observers of spectroscopic phenomena. The price of the book, with a coloured chart of spectra, is 1*s.* 6*d.*, and without the chart, 9*d.*

OUR ASTRONOMICAL COLUMN.

New Elements for Halley's Comet.—In a note appearing in No. 419 of the *Observatory* (February, p. 104), a set of elements for Halley's comet, deduced by Mr. C. J. Merfield from the observations made since the re-discovery of the comet in September last, is compared with the elements predicted for this return, as follows:—time of perihelion passage, April 19·6394 (G.M.T.), $\omega = 110° 43' 24''$ (=predicted + 68″), $\Omega = 57° 15' 56''$ (=predicted − 16″), $i = 162° 12' 34''$ (=predicted − 8″), $e = 0·967300$ (=predicted + 0·000019″), and $\mu = 46·6723''$ (=predicted + 0·003″). From these elements Mr. Crommelin has calculated the conditions for the comet's transit over the sun, and finds that the first contact should take place on May 18d. 14h. 22m. (G.M.T.) in position angle 264°. Thirty minutes later the centres of the two bodies will be at their least separation, the comet being 62″ south. Last contact should occur at 15h. 22m., in position angle 92°, and the horizontal parallax of the comet will be 54·4″, or 45·7″ relative to the sun. The transit will be visible in Australia, the Pacific, and Asia, and it is sincerely to be hoped that careful and comprehensive observations will be made, for they may provide useful additions to our knowledge concerning the constitution of the denser portions of the comet.

In the same journal Father Cortie discusses the alleged Papal excommunication of Halley's comet ("The Devil, the Turk and the Comet") in 1456, and quotes conclusive evidence showing the story to be a myth.

Studies of Solar and Stellar Spectra.—In two recent communications to the Academy of Sciences (*Comptes rendus*, Nos. 1 and 3), Count A. de Gramont publishes some interesting results as to the occurrence of what he designates *raies ultimes* in the spectra of the sun and various stellar types.

The *raies ultimes* of an element are those lines which persist in the spectrum throughout the range of flame, arc, and spark conditions. Treating different alloys in which the quantity of a component continuously decreases, M. de Gramont finds that the first lines to disappear from the spectrum are the "spark" lines, then those produced in the arc, and lastly the "flame" lines; the most persistent lines are the *raies ultimes*. On the hypothesis that the spectra of the various regions of the sun are dissociation spectra, and that their differences are due principally to variations of the proportions of elements present, M. de Gramont hopes to find indications which will show, more or less, the regions of the sun, and he gives a list of the most persistent and the most sensible lines of seventeen elements already traced in the solar spectrum.

M. de Gramont further points out that the absence of the lines of the metalloids, &c., from the solar spectrum should not be accepted as proof that these substances do not exist in the sun, for he has already shown that the "ultimate" lines of many of them exist in the more refrangible part of the spectrum which our atmosphere absorbs. The "ultimate" lines of gold occur at λλ 2676·0 and 2428·1, and it is suggested that this is the reason that gold has, so far, been considered as absent from the sun.

In the second paper M. de Gramont considers the distribution of *raies ultimes* in different stellar types, having studied for this purpose the Harvard classifications, the numerous publications of Sir Norman Lockyer, and the works of Sir William Huggins. Using the nomenclature of Miss Cannon, in the Draper Catalogue, he finds that these ultimate lines do not occur in the hottest stars, but make their appearance in B8A, the Algolian type, and generally increase in intensity as the lower types are reached. In the *c* division the "ultimate" lines appear at a stage later, and in less numbers, than in the *a* division. M. de Gramont points out that the *c* division corresponds with Sir Norman Lockyer's "ascending series," of which the most characteristic types are the Rigelian and the Cygnian, in which predominates the "test spectrum" or spectrum of enhanced lines. The presence of oxygen and nitrogen lines in the helium stars, lines dissimilar to the ultimate lines, is taken as an indication that in such stars powerful electrical discharges are in action.

M. de Gramont concludes by suggesting that the presence or absence of "ultimate lines" in the spectra of stars may furnish valuable indications of the relative temperatures, or the stage of evolution, of the different types, and is equally applicable to the Harvard classification and the conceptions of Sir Norman Lockyer.

Markings on Mars.—Too late for insertion at the end of his letter on Martian markings as seen with small and large telescopes, published in last week's Nature (p. 397), Prof. Lowell writes:—"It will prove of interest to students of the subject that this optical shattering of lines, due to a large glass, is precisely what M. Antoniadi observed at Meudon in his observations of Mars. He saw in the canals, in place of lines, a tesselated series of dots. His observed mosaic effect is the exact theoretic effect that a large aperture should produce on continuous lines such as the canals, and always does produce in the case of the rings in the images of a star."

Elements and Ephemeris for Tempel's Comet (1873 II.).—In No. 4386 of the *Astronomische Nachrichten* M. Maubant gives the elements and a search-ephemeris for Tempel's second comet, which is expected to pass through perihelion in the near future. The conditions are not favourable for observation.

THE NEW COMET (1910*a*).

Although by its increasing distance from the sun and the earth, and by its apparent recession into the sun's rays, the great comet of 1910 is becoming less popular as a spectacle, the interest among astronomers as to the results accruing from the mass of observations will doubtless continue for a long period. From observers situated in many parts of Europe and Africa we are receiving further evidence of this comet's title to rank among the "great comets" of history.

In sending us the drawing here reproduced, Father Cortie encloses some valuable observations of the comet's appearance on January 26. The drawing was made by Mr. William McKeon, an assistant at the Stonyhurst College Observatory, at 6 p.m. January 26, and in making the observations a small pocket telescope of 1½ inches aperture and 17 inches focal length was employed. The following are Mr. McKeon's remarks concerning the comet's appearance at the time:—"Nucleus of the comet bright and sharp; no merging into the tail, magnitude 2. Nucleus of comet 2° S. and 7° W. of Venus (estimated). The tail terminated at a star of about the seventh magnitude some 8° N. by E. of the head. The star to the right of the comet (N. by W.) was of about the third or fourth magnitude."

Father Cortie identifies this latter star as α Equulei, magnitude 4·1, and thence deduces that the length of the tail, as seen in the small telescope employed, was about 7½°. Naked-eye observations by himself showed the tail extending almost to ε Pegasi, which would make its length 12°; its breadth at the end, he estimated, was about 3°. The sky was perfectly clear, and the tail of the comet was quite a conspicuous object after the head had set, until it was lost in the moonlight. As the drawing shows, there was, in addition to the two main branches of the tail, separated by a dark segment, a fluffy extension on the eastern side; all these features are shown on the photographs taken the same evening, and mentioned in Nature last week.

Further observations were made on January 29, and, although the sky was less clear, the length of the tail was estimated by Father Sidgreaves to be 17° or 18°; the general brilliancy of the comet was less.

Father Cortie also records some observations made by the Rev. J. Rowland at St. Asaph, N. Wales, who directs attention to "a faint general illumination of the sky to the east of the tail, of a width apparently of 10° to 15°, the length of the tail being over 20°. There was also an apparent deviation of the tail to the east between α and γ Pegasi." This confirms the independent observations, made at Stonyhurst and elsewhere, as to the apparent existence of a cloud of particles following the eastern branch of the comet's tail.

Mr. Theodore Kensington, West Malvern, also mentions a similar phenomenon. He says, in a letter dated February 5:—"The comet was a magnificent sight from the Malvern Hills a week ago, and of even more than ordinary interest owing to the glare which was visible, in apparent connection with it, on its southern side. This glare was best seen on the evenings of January 29 and 30, but it was also visible last Wednesday and Friday."

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The comet as seen at Stonyhurst on January 26 by Mr. McKeon.

Mr. Kensington further states that the glow was like that from a distant city or an aurora, but that it was not terrestrial was shown by its setting with the stars. It was like an inverted **U** the right side, bounded by the comet and the square of Pegasus, reaching nearly to Saturn, while the left (south) side descended almost perpendicularly, but with a slight trend inwards, to the visible horizon. The distinction between the bright background on the one side of the comet and the dark sky on the other side was quite marked, but after January 29 there was a darker band of sky between the comet's tail and this glow.

Miss Eleonora Armitage, writing from Dadnor, Herefordshire, states that the glare seen in the neighbourhood of the comet was the zodiacal light, which showed particularly well on January 29. She adds:—"The tail of the comet was well defined on the west side, reaching a little beyond and above α Pegasi, as seen with the naked eye; on the east side it could be traced almost so far as γ Pegasi, but along most of this side the edge was very indefinite, owing to the light practically blending with that of the zodiacal light, both having apparently the same degree of luminosity. β Aquarii could be seen through the tail a little above the nucleus of the comet. The next evening, January 30, the comet was much fainter, but the tail could still be traced for nearly 30°, while the zodiacal light stretched up in a bright cone, the apex almost reaching to Saturn. When seen again on February 4 the northern movement of the comet had removed it from the track of the zodiacal light, so that the two lights appeared to be separated by a segment of dark sky, the eastern edge of the curved tail being now nearly as clearly defined as the western."

Reports from other observers indicate that the zodiacal light has been well seen on several occasions during the past fortnight. Dr. F. J. Allen saw it and the comet, under ideal conditions, from the Mendip Hills on January 30, and suggests that the "glare" near the comet as seen by other observers was doubtless the light. A correspondent ("E. W. P.") at Ross, Herefordshire, also states that "the zodiacal light was distinctly seen this evening at 6.45 (February 4), whilst the tail of the 'daylight' comet seemed to reach further than ever."

Dr. Allen's observations of the comet are of especial interest, for he remembers distinctly the comet of 1858 (Donati's), and has seen all the bright comets since, and states that, as he saw it on January 30, 1910a is the only one which can be compared in effect with Donati's. The intermediate ones, though brighter than the present one, were poor little things in apparent size. He suggests that the estimates of its apparent size have erred on the side of cautiousness. As he saw it at Cambridge, during the early days of its appearance, his estimates agreed with the usual ones; but as seen from the Mendips, smoke, gaslamps, and clouds being absent, and the night exceptionally clear, the tail reached beyond and included α Pegasi, and then took a more pronounced curve to the left. He estimates its length as 40°, and suggests that, had the zodiacal light been absent, the tail might have been traced further, for the light rendered its S.E. limit indefinable; his observations extended for more than an hour, between 6 p.m. and 7.30 p.m. Prof. R. A. Gregory, observing at Chichester on January 29 and 30, found that the tail was certainly 30° long, whilst M. Giacobini reports (*Comptes rendus*, vol. cl., No. 5, p. 263) that, as seen by the naked eye at the Paris Observatory, on January 29, its length exceeded 45°. M. Chofardet, at Besançon, states that on January 27 the tail was 25° long, and, curving towards the south, mixed its light with that of the zodiacal light.

In a further communication, Mdlle. de Robeck, observing at Inistioge, Kilkenny, states that on January 29 the comet appeared very much in the same way as shown in Mr. Rolston's sketch in last week's Nature, but the tail seemed to reach higher, and swept upward nearer to α Pegasi. After Venus had set, the tail of the comet was seen like a great search-light sweeping the sky, and the fainter stars below Pegasus were seen glittering brightly through it; the night was exceptionally clear at Inistioge. Mdlle. de Robeck also states that, before the comet became such a noticeable object, the country people around Inistioge took Venus to be the much-talked-of object, and saw in it a portent of dreadful calamities. That the Earl of Crawford's suggestion (Nature, January 20, p. 349) was an urgent one is proved by the reports of "comet scares" in Russia, Turkey, and other countries, occasioned by the sudden and unexpected appearance of 1910a. It certainly would be well to prepare the native minds for the apparition of Halley's comet when, as Mr. Cowell thinks it will, it becomes sufficiently bright and large to attract general attention.

Mr. Keeling, of the Helwan Observatory, Egypt, reports that the comet (1910a) was observed on several evenings at Helwan, Egypt, and photographs of it were obtained on January 24, 25, 27, and 28; the camera employed has a Cooke lens of 4 inches aperture and 28 inches focal length. Naked-eye observations on January 27 and 28 showed the tail to be 24° to 25° in length.

A telegram from Dr. Aitken (*Astronomische Nachrichten*, No. 4386, p. 292) states that Dr. Albrecht finds the sodium lines in the spectrum of the comet to be so displaced as to indicate a recession of ·66 km. per sec. in the line of sight. As the position of these lines has now, apparently, been measured with sufficient accuracy to justify a definite statement as to "shift," it seems very improbable that the yellow lines observed are due to helium, unless two sets of such lines have been observed, and there is no suggestion of this. In this regard Mr. Hinks writes to us disclaiming the statement attributed to him by a reporter, as mentioned on p. 410 last week, and states that "there is no truth in this reported unconventionality."

Spectroscopic observations of the comet, made at Meudon, are described by MM. Deslandres, Bernard, and d'Azambuja in No. 5 of the *Comptes rendus* (vol. cl., p. 253).

Using the prismatic cameras previously employed on the Morehouse and Halley comets, photographs were obtained on January 22, 24, 25, 27, 29, and 30. Orthochromatic, red-sensitive plates were used, and the best negative of January 22 was secured with an exposure of five minutes. This shows a brilliant nucleus giving a continuous spectrum from λ 700 to λ 420 and several condensations.

The brightest condensation is at λ 590, and is recognised as due to sodium; it shows a complete monochromatic image of the comet with a well-defined tail, brightest at its edges and extending to a distance of 20′ of arc from the head. The hydrocarbon bands at λ 560 and λ 470 are also recognisable. In addition to these, there are two condensations at λ 620 and λ 700 extending some 10 minutes of arc into the tail, and not previously recognised in cometary spectra.

The later photographs show the progressive differences which have been observed in other comets (*e.g.* that of 1882) having small perihelion distances; the sodium lines faded gradually, while the hydrocarbon bands became more intense, and those due to cyanogen made their appearance.

On January 29 and 30 the sodium bands were absent, the hydrocarbon bands (λλ 565, 517, 474) stronger than before, the continuous spectrum extended into the ultraviolet, and the cyanogen bands at λλ 388, 387, 386 were complete and intense.

The wave-lengths given now are, necessarily, only approximate, but other photographs, taken at the same time with a slit spectrograph, will give finer values, which are promised in a later publication.

Ordinary photographs were also secured, and those taken on January 22 show a fine, curved tail divided into two "antennæ" with a dark line down the centre. On January 29 a supplementary tail was shown, nearly as intense as the first, and making an angle with it of about 25° towards the south.

Observations made with a simple Nicol on January 29 indicated that the light from the tail was strongly polarised in the plane containing the sun, the comet, and the earth.

The *Astronomische Nachrichten* also contains the elements and ephemeris by Dr. Kobold, from which we gave an extract last week, and the records of a number of observations made at the Continental observatories. At the Bothkamp Observatory on January 23, 4h. 50m. (M.T. Bothkamp), Dr. Schiller found the comet to be of the first magnitude, and to have a sharply defined nucleus of 4″ diameter. He reports, also, that the head was very similar to that of Donati's comet shown in Fig. 153 of the third edition of Newcomb-Engelmann; the position-angle of the medial line of the two tails was 40°. On January 23 the comet was fainter, but, to the naked eye, the tail appeared to extend to a distance of 15°.

Later elements and ephemeris are published in Circular No. 119 from the Kiel Centralstelle, and are based on observations made on January 20, 23, 26, and 30; they are as follows:—

Elements.

T = 1910 January 17·1235 (M.T. Berlin)

$$\left.\begin{array}{l}\omega = 320^\circ\ 58{\cdot}64' \\ \Omega = \ 88^\circ\ 47{\cdot}14' \\ i = 138^\circ\ 47{\cdot}12'\end{array}\right\}1910{\cdot}0$$

$\log q = 9{\cdot}11153.$

Ephemeris (Midnight, Berlin).

1910	R.A. h. m.	Decl. ° ′	Magnitude
Feb. 10	21 54·4	+ 7 40·8	4·0
12	21 57·2	+ 8 24·8	
14	21 59·8	+ 9 5·5	4·4
16	22 2·3	+ 9 43·5	
18	22 4·6	+10 19·1	4·8
20	22 6·8	+10 52·8	
22	22 8·9	+11 24·9	5·0

The magnitudes are based on the observation that the magnitude on January 27 was 2·0, and are independent of any physical changes in the comet itself.

We notice that the misnomer "Drake's comet" is still being employed. As this is likely to lead to subsequent confusion, it would seem as well to refer to this object as the "Worssell-Innes comet, 1910*a*," Messrs. Worssell and Innes, of the Johannesburg Observatory, having been the first to make and record any definite observations of it.

A FINNISH ETHNOLOGICAL EXPEDITION TO BRITISH PAPUA.

ABOUT the middle of this month Dr. Gunar Landtman, lecturer in sociology at the University of Helsingfors, will leave London for an ethnological expedition to British Papua. In 1904 Dr. Landtman attended the Martin White lectures on sociology that were given in the University of London by Prof. E. Westermarck and those on ethnology by Dr. A. C. Haddon. In 1905 he wrote his doctor's dissertation "On the Origin of Priesthood," and in 1909 published a thesis on "The Primary Causes of Social Inequality." Dr. Landtman will make the island of Badu, in Torres Straits, his headquarters; thence he expects to proceed to Saibai, and later to that portion of the mainland of British Papua which faces Torres Straits, and is known to the natives as Daudai, and, gradually working his way eastwards, he will eventually study the natives of various islands in the delta of the Fly River. Very little is known about this district, and it is important that it should be investigated before the natives are further modified by contact with the white man.

The ethnography of the islanders of Torres Straits has been carefully described by the members of the Cambridge Anthropological Expedition to Torres Straits, and it is fortunate that their results will now be linked on to the mainland of New Guinea, for there is no doubt that the western and eastern islands of the Straits were populated by various emigrations from the mainland. Friendly relations have always been maintained between the islanders and the mainlanders, and a good deal of simple trading has taken place between them; but most interesting of all is the culture influence that formerly extended from the mainland to the islands. In the island folk-tales we hear of the introduction of ceremonies (in most of which masks were employed) by men who seem to have been actuated by a missionary spirit, and the most important of the hero-cults of the central and eastern islands appears to have come from New Guinea. It is Dr. Landtman's intention to endeavour to trace these to their sources.

Totemism is known to occur in the district about to be investigated, where, for some unexplained reason, plant totems are more abundant than animal totems. We may also expect to learn something about the origin of the hero-cult of the islanders, but we do not in the least know whether these legendary persons are heroes in their own country. To the east, along the shores of the Papuan Gulf, the Rev. J. Holmes has discovered a belief in gods who appear to be apotheosised ancestors. It is remarkable that this is the only district of British Papua from which gods have been recorded, but we do not know the western limit of this belief.

A careful study of the social customs and religious beliefs and practices of the natives of Daudai and of the Fly River delta will reveal to us whether their totemism is in a typical condition or whether it is being modified by superior cults, and it is very desirable that a metamorphosis of this kind should be accurately recorded. There are many other problems connected with this interesting region that require elucidation, and we wish Dr. Landtman every success in his undertaking. Dr. Landtman would like to spend at least two years in the field, but is at present uncertain whether he will not have to content himself with one year. On his return he proposes to spend about nine months in Cambridge in order to work out his results, which will be published in English.

RECENT WORK OF GEOLOGICAL SURVEYS.[1]

II.

South Africa and Australasia.

THE Geological Commission of the Cape of Good Hope has issued Sheets 33 and 41 of the geological map of the colony on the scale of 1/238,000, covering the country to the north-east and south-east of Prieska, and just reaching to De Aar. A long stretch of the Orange River wanders through Sheet 41, and its excavating action has here and there revealed the rocks below the prevailing Dwyka series. To the north-west the ground rises, and the Transvaal system, with the dolomites, appears in force. Sheet 33 is a remarkable performance considering the small staff of the Survey, and shows the sinuous outcrops of the Karroo doleritic sheets invading the Ecca shales and the Dwyka series over 3000 square miles of country. Complicated inliers of the older rocks appear in the north-west. The country shown in these maps is described in the Annual Report of the Geological Commission for 1908 (1909). The ring-like outcrops of the igneous sills in Sheet 33 are explained by the presence of tectonic basins, whereby an escarpment of dolerite, facing outwards, encloses an area of overlying Ecca shales. On p. 111 of the report Mr. A. L. du Toit describes the kimberlite and allied pipes and fissures in the Prieska-Britstown region, giving interesting sections to show the typical dome-formation in the strata where the pipes have broken through. A careful study has been made of the inclusions of garnet-granulite and eclogite that are so characteristic of the pipes, and the author shows that they have been brought up from rocks, possibly of sedimentary origin, that were metamorphosed at considerable depths. Dr. A. W. Rogers (p. 135) has re-examined the Tygerberg near Prince Albert Village, and continues to maintain, in opposition to Dr. Sandberg, that the structure is that of an ordinary anticlinal (see NATURE, vol. lxxvi., p. 423).

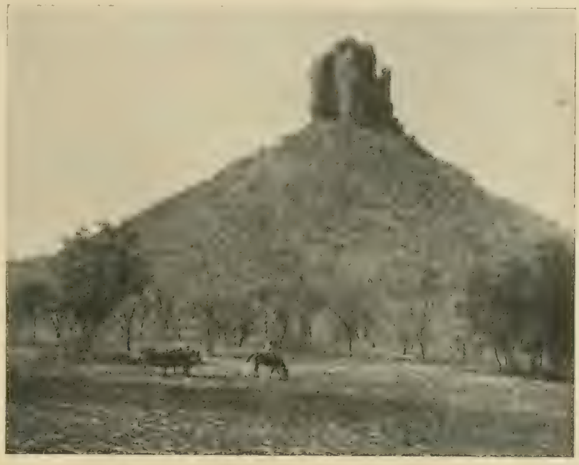

Fig. 1.—Kopje of Waterberg Sandstone, country west of Potgietersrust, Transvaal.

The Geological Survey of the Transvaal Mines Department shows great vitality. The large areas mapped and reported on in a year may be seen in the maps recording progress, appended to the reports for 1907 and 1908. In the report for 1907 (received in July, 1909) attention is properly directed by the Secretary for Mines to the inter-relation of the so-called scientific and economic duties of the Survey. From time to time a brief defence of this kind becomes necessary; but it requires some delicacy, since few geologists would like to set down in print the extraordinary ignorance of earth-structure prevailing among prospectors and "practical men." Support could always be given, however, to colonial surveyors by those in European countries, who know how small details of dip, unconformity, or rock-sequence shown upon their laborious large-scale maps, or perhaps revealed by palæontological studies, prove again and again of service to inquirers in directing their operations or in diverting them to more profitable fields. Geological surveys play, moreover, a high educational part in explaining the features and historical development of a country, and it should be the pride of a growing nation to allow natural sciences to take the place that has been accorded to dead languages in more conservative lands. In the report for 1907 Mr. A. L. Hall describes the geology of the Haenertsburg goldfields, and shows (p. 53) how the stratified rocks of the Pretoria series have been metamorphosed by the Bushveld granite, yielding every variety of type, from bedded shales with new minerals to strongly marked schists and gneisses. He urges that, while pressures have operated during this contact-alteration, dynamic metamorphism is insufficient to account for the phenomena. The rocks illustrate the spread of material along schistose surfaces perpendicular to the pressure (Rieke's principle), and the production of minerals of small molecular volume (Lepsius's law of volumes). We should like, however, to hear more of the relation of the foliation-planes of the most altered types of shale to the original bedding, since we believe that these features are frequently coincident in highly altered contact-rocks. Chromite occurs concentrated in bands in the hypersthenite of the Lydenburg district (p. 59), and similar bands are described by Mr. Humphrey (p. 89) in the norite of Kroonendal, near Rustenburg. Mr. Hall has been able to extend his conclusions as to the potency of contact-metamorphism to the country south-west of Rustenburg (p. 66). Mr. Kynaston reports on the cassiterite deposits in the Waterberg district, where the hilly ground falls northward to the Limpopo. The ore is found in granite in pipes of circular or oval section, which are formed of highly altered granite, with ore concentrated towards their margins (pp. 97 and 100). These are compared with smaller occurrences in New South Wales. Our knowledge of Waterberg is extended by Messrs. Kynaston and Mellor in the report for 1908. The Waterberg Sandstones, which are somewhat like our Old Red Sandstones, form characteristic tower-like kopjes (Fig. 1). The pipes of tin-ore occur on each side of the granite ridge that runs north-west near Zaaiplaats, and are already being well developed (p. 46). In a country where fossiliferous strata are so rare, petrography naturally plays a large part, and the metamorphic zones of both the older and younger granite receive careful description in various papers in this report. The younger granite of Waterberg, a handsomely red rock, yielded boulders to the Upper Waterberg series, but continued to send off-shoots into this series in the Hoekbergen and the Middleburg district to the south-east. Deposits of manganese, zinc, and lead ore, and of gold are described by Mr. W. A. Humphrey from the Marico district away west; the Malmani goldfield, which has been worked sporadically, lies not far from Mafeking. These reports, which are priced at only 7*s.* 6*d.* each, are, as usual, well illustrated by landscapes and by coloured maps and sections. The Survey has also issued a special octavo memoir on the Waterberg tinfields (1909, price 7*s.* 6*d.*), in which the conclusions and illustrative sections are reproduced in a convenient form. The ore-bodies are discussed in detail, and a small example of the remarkable cylindrical pipes is well shown in a photograph in Plate viii.

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[1] Continued from p. 382.

The Annual Report of the Geological Survey of Western Australia for 1908 (Perth, 1909) contains an account of the phosphatic deposits of Christmas Island, by Mr. H. P. Woodward. The travertine that has become phosphatised from above is about 2 feet thick, and is ascribed to the evaporation of capillary waters, which bring calcium carbonate in solution from underlying shelly sands. This kind of rock may be matched in South Africa and in other countries where rains are only seasonal. The fundamental rocks appear along the coast and in bold hills at the north and south ends of the island. They are granite, gneiss, and schist, with basic dykes rich in magnetite. A large number of analyses of the phosphatic beds and a map of the island are supplied. The Survey has reprinted three earlier bulletins on the Pilbara goldfield in a compact little volume (1908), with a large number of folding maps and plans. This goldfield is in a tropical region east of the Yule River. The gold occurs in quartz-reefs, mainly in a green schist series, which is probably of igneous origin. Alluvial tin-ore is also worked, and has been traced to local granite masses. Bulletin No. 32 (1908, price 2*s.*) is also a guide to miners in special districts. The tests given for the ready discrimination of ores are an excellent feature, and that on p. 12, for cassiterite in a concentrate of similar heavy minerals, is new and fascinating. Native tin has been found (p. 22) in the Greenbushes tinfield in the south-west of the State, and is attributed to the action of bush-fires on surface ores. Tantalite is of growing importance in Australian fields. Mr. Gibb Maitland pointed out some years ago that the laterite of the Greenbushes area is being denuded away. Mr. H. P. Woodward now states (p. 31) that the deposit appears in places as a zone between two alluviums. It has resulted from the alteration of rocks as diverse as diabasic schist and alluvium, under conditions of climate that may have been recurrent, but which do not now prevail. Bulletin No. 35 (1909) deals with the gold and copper deposits of the Phillips River Goldfield, about 150 miles east of Albany. The basic schists of the region are capped by laterite and the serpentines by magnesite (p. 10); bands of laterite, moreover, traverse the country like lodes, but are believed to be only the weathered tops of basic igneous dykes (p. 12). Certain andalusite-sericite schists are attributed to the alteration of granites rich in soda and alumina (pp. 21 and 23). The coloured map of Ravensthorpe is impressive, with its grand series of basic dykes running across the granite from a greenstone region in the north-west. These dykes can usually be recognised across country by the rich red soil upon them. Bulletin No. 37 (1909), by Mr. C. G. Gibson, is of imperial importance, being a description of the geology along the proposed transcontinental line of railway through Australia from west to east, so far as the route lies in the State of Western Australia. The illustrations of camels procuring water at small holes in bush and desert are not encouraging to the townsman, but will probably serve only as a stimulus in these lands of healthy enterprise. These remarkably cheap reports, in which maps and memoirs are combined, must be of immense service in a country intent on understanding its resources.

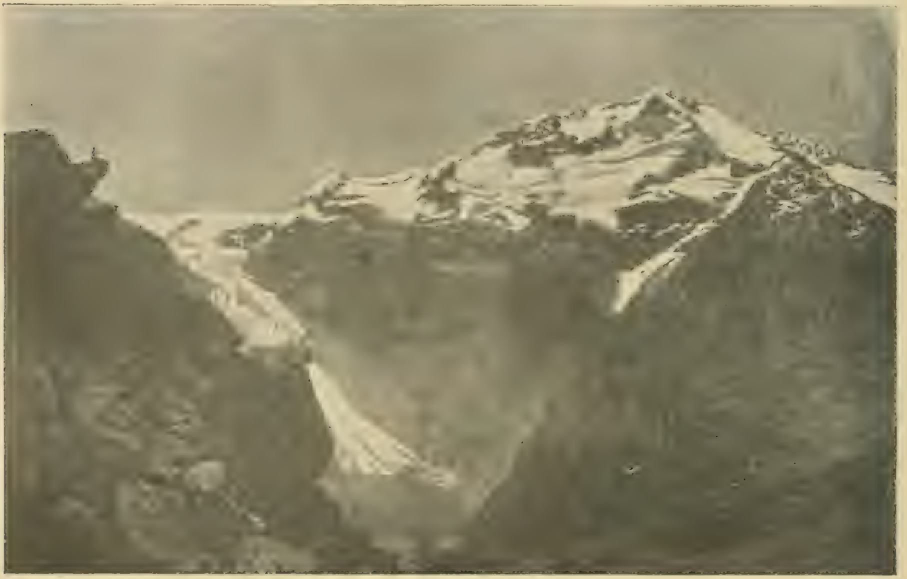

FIG. 2.—Mount Lambert, New Zealand Alps, with glacier broken by a precipice in its descent.

The Secretary for Mines for South Australia issues a review of mining operations in the State for 1908 (Adelaide, 1909). Mr. H. Brown describes certain phosphate deposits (p. 21), which have a general interest because of their interstratification with Cambrian clays, sandstones, and limestones. It is suggested, as in the case of the Welsh beds, that the calcium phosphate results from the abundance of organisms which utilised it in their shells in Palæozoic times. At present these deposits are overshadowed commercially by Christmas and Ocean Islands.

The Geological Survey of New South Wales issues a report and map, by Mr. E. C. Andrews, on the Drake Gold and Copper Field, where folding at the close of Carboniferous times was accompanied by successive intrusions of granitic magmas of decreasing basicity. Dioritic dykes then broke through, with which the gold, copper, lead, and silver ores are associated. The mineral features are thus of early Mesozoic age (p. 6). The porphyritic hornblende-granite of Malarra (p. 9), a member of the earlier intrusions, seems of unusual attraction as an ornamental stone. There is a somewhat exceptional mingling of sound geology and mining applications in this compact report. The Survey shows a keen interest in palæontology in its Records, vol. viii., part iv. (1909, price 7*s.* 6*d.*). Mr. R. Etheridge, among other contributions by him, describes a large tubular organism from Gotlandian strata, allied to the Carboniferous Mitcheldeania. Dr. A. S. Woodward adds to our knowledge of the labyrinthodont Bothriceps. Mr. G. W. Card continues his painstaking determinations of the minerals of the State, and the analyst, Mr. J. Mingaye, supplies details of importance to all chemists as to the modes of separation of thoria from monazite (p. 276).

Mr. W. E. Cameron has written for the Queensland Geological Survey a second report on the Etheridge Goldfield (Brisbane, 1909), where the ores occur in reefs in granite, or associated, like those of the Drake Field in New South Wales, with basic dykes, which here penetrate schists. The Survey has also issued a third edition of a very useful geological and mining map of Queensland, on the scale of 1 inch to forty miles.

In Bulletin No. 6 of the New Zealand Geological Survey (1908, price 2*s.* 6*d.*) Mr. P. G. Morgan describes the southern part of North Westland, on the western coast of the South Island. The author feels strongly that high ground existed in the oceanic area to the west down to the commencement of Pliocene times (pp. 34 and 37), and that this land disappeared only when the present Alps of New Zealand rose towards their maximum height. A relic is believed to remain in the Carboniferous Greenland series (p. 96), which is folded almost at right angles to the trend of the Southern Alps. The conglomerates of the Oligocene or Miocene Koiterangi series (p. 102) are at first glacial and then fluviatile, and their pebbles may have descended from the old western highlands. The modern glacial features of the interior furnish material for several striking photographs (Fig. 2).

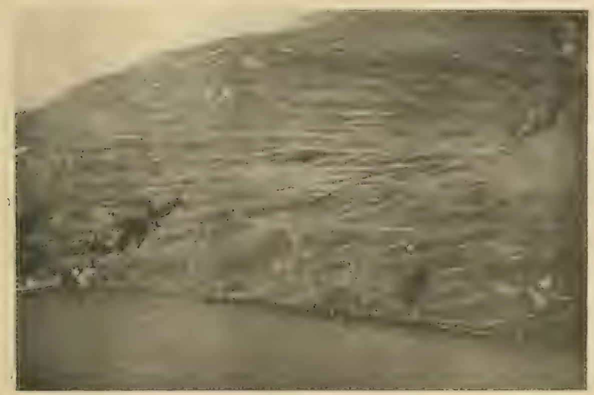

FIG. 3.—Ice-carved terraces on slope of Ben More, Western Otago.

Prof. James Park, in Bulletin No. 7 (1909, price 2*s.* 6*d.*), has an equally grand field in the Queenstown subdivision of western Otago. Queenstown lies on the winding Lake Wakatipu, which is fifty miles in length, and close against serrated Alpine ranges. The main theme of this splendidly illustrated monograph is the evidence for widespread Pleistocene glaciation in the South Island. All the signs of confluent glaciers, developing into an ice-sheet, are here brought together in an argument that appears complete. The decline of the ice seems to have been as rapid as in Europe, giving rise to "unparalleled fluviatile activity" (p. 41). The late Pliocene elevation of the country is held to have had considerable influence on the refrigeration, and the Pleistocene subsidence was accompanied by recession of the ice. Striated surfaces, boulder-clays, drumlins, eskers, and all the features familiar in our hemisphere, are here illustrated from 45° south latitude. Especially remarkable, however, are the terraces carved out on Ben More above Lake Luna, in a quartzose mica-schist (p. 31), which Prof. Park believes to be unique features of ice-erosion (Fig. 3). The author contributes a short essay on ice-flow and the excavating powers of glaciers. References to the structure of glacier-ice and to experiments on its plasticity would have rendered this more complete, but enough is said to excite interest. The bulletin concludes with an account of local gold-mines, and the maps cover the important areas in which alluvium has been worked, or in which the quartz-reefs seem of promise. As usual, for beauty of illustration and the excellent production of the accompanying maps, these New Zealand bulletins remain unsurpassed.

G. A. J. C.

THE LINNEAN SOCIETY'S DISCUSSION ON THE ORIGIN OF VERTEBRATES.

DURING the past fifty years one of the chief tasks to which zoologists have applied themselves has been the reconstruction of the phylogeny of the animal kingdom in accordance with the principles of evolution laid down by Charles Darwin. This task is still far from being completed, although no one can doubt that very substantial progress has been made. The evidence is still very imperfect, and every increase of knowledge makes more clear the need for extreme caution in drawing conclusions. When we think of the familiar comparison of the animal kingdom to a luxuriantly branching tree of which only a few of the topmost twigs are known to us in the living condition, while at the same time we are only able to recover from the past the most fragmentary records of the millions of extinct forms, we are able to realise why it is that most zoologists at present refuse to commit themselves to any particular theory of the origin of vertebrates. Of course, numerous theories have been put forward from time to time, but none has met with anything like general acceptance, and there appears to be a widespread feeling that in the present state of our knowledge any such theory is somewhat premature. The discussion of the subject, however, cannot fail to be of use in stimulating thought, and the debate which has occupied the last two meetings of the Linnean Society has naturally aroused considerable interest.

Dr. Gaskell, as opener, expounded, in his usual brilliant style, his own particular theory of the origin of vertebrates from an arthropod ancestor. This theory has already been before the scientific public for many years, but has met with little favour amongst professional zoologists, most of whom find it impossible to believe that a highly specialised Limulus-like arthropod could have given rise to such a very different type of organisation as the vertebrate. Dr. Gaskell, as is well known, bases his argument mainly upon his study of the Ammocœtes larva of the lamprey, between which and the king-crab he endeavours to draw a very close comparison.

The keynote of this comparison lies in the central nervous system. The ventricles of the brain, with their lining epithelium, are supposed to represent the arthropod stomach, and the central canal of the spinal cord the intestine. The infundibulum is the ancestral œsophagus, and the neurenteric canal the ancient vent. Around this tubular foundation the various ganglia of the arthropod nervous system have become arranged to form the nervous tissue of the vertebrate brain and spinal cord. The original functions of the ancestral alimentary canal have disappeared, and it has been finally replaced by an entirely new structure developed from a respiratory chamber in some palæostracan ancestor. This theory, of course, lands us in a serious difficulty from the embryological point of view, for if we accept it we must admit that the germ-layers in arthropods and vertebrates are not homologous—that the epiblast of the one becomes the hypoblast of the other, and *vice versa*. Dr. Gaskell does not find this difficulty by any means insuperable, and, as part of his argument, runs a tilt against the germ-layer theory as at present accepted. In this he was largely supported by the subsequent observations of Dr. Gadow and Prof. Stanley Gardiner.

The debate naturally centred around Dr. Gaskell's theory, which was discussed from the standpoints of embryology, comparative anatomy, palæontology, physiology, and even psychology, the subsequent speakers being Prof. MacBride, Prof. Starling, Mr. Goodrich, Dr. Gadow, Dr. Smith Woodward, Prof. Dendy, Sir Ray Lankester, Dr. Chalmers Mitchell, Prof. Stanley Gardiner, the Rev. T. R. R. Stebbing, and the president (Dr. D. H. Scott). Dr. Gaskell replied at length at the end of the second evening.

It is impossible in this article to give more than a very general account of the course of the discussion, and this is the less necessary as the Linnean Society has announced its intention of publishing it in full, while Dr. Gaskell's views have recently been given to the world in book form.

For reasons which have already been indicated, no definite theory was put forward as a rival to that of Dr. Gaskell, though probably no competent zoologist would have much difficulty in formulating such a theory. Amphioxus, however, loomed large, especially in the remarks of Mr. Goodrich. Dr. Gadow, whose remarks, on the whole, tended strongly to support Dr. Gaskell, expressed the opinion that the attempts which have been made to bring Amphioxus into line have not been successful, but it was pointed out that this animal, though in some respects undoubtedly modified—according to Sir Ray Lankester, even degenerate—nevertheless more nearly resembles a primitive vertebrate than any other animal living at the present day. Probably no zoologist now claims it as being in the direct line of descent of the higher vertebrates from their invertebrate ancestors, but it has gone off on its own little side-track for only a short distance from the starting point. In many respects it retains primitive vertebrate characters, such as the notochord, the numerous gill slits, and the comparatively undifferentiated central nervous system (which may, however, be partly explained as due to degeneration). It shows hardly any sign of cephalisation, and no trace of the paired sense organs which form so dominant a feature of the organisation in higher vertebrates. It represents an altogether lower grade of organisation than the lamprey or even the Ammocœtes larva, yet, as Dr. Goodrich clearly showed, there is no difficulty in deriving the lamprey from an Amphioxus-like ancestor by a normal process of evolution in which cephalisation has played the leading part. If, however, we accept an Amphioxus-like ancestor as the starting point of the vertebrate phylum, we must put the arthropod theory out of court at once, for many of the structures upon which Dr. Gaskell lays much stress as evidence in support of his theory, such as the lateral and pineal eyes, have not yet appeared at the commencement of the vertebrate series, and must have been evolved within the limits of the phylum.

As to what preceded the Amphioxus-like ancestor of vertebrates, zoologists, as already observed, refuse to commit themselves to an opinion. They await more evidence. In the meantime, it is pointed out that the possession of nephridia with solenocytes, identical with those of certain chætopod worms, suggests annelidan affinities, and that the worm-like Balanoglossus, with its Amphioxus-like gill slits but very dubious notochord, must also be taken into account, while the evidence of embryology points to some far remote relationship between Amphioxus, Balanoglossus, and the echinoderms.

The chief difficulty in the way of comparing the vertebrate with the annelid lies, of course, in the reversal of the surfaces which such comparison implies. In the annelid the principal part of the central nervous system lies ventrally beneath the gut, in the vertebrate it lies dorsally above the gut. Dr. Gaskell maintains that the old way of getting over this difficulty by turning the animal upside down and making the dorsal surface of the vertebrate represent the ventral surface of the invertebrate ancestor is now universally discredited. Yet we find Prof. Sedgwick saying in his "Text-book of Zoology," so recently as 1905, that it is quite clear that the dorsal surface of the vertebrate corresponds to the ventral surface of other cœlomates, a view which is strongly supported by the history of the ascidian tadpole, in which the mouth is dorsally situated, instead of ventrally, as in higher chordates.

A considerable amount of detailed criticism of Dr. Gaskell's theory was, of course, brought forward during the discussion. Prof. MacBride pointed out that the skin of the primitive vertebrate must have been ciliated, while in the arthropod the entire organisation is dominated by the production of a thick, chitinous cuticle. He also spoke in defence of the germ-layer theory, and criticised Dr. Gaskell's explanation of the hollow gastrula stage of the arthropod Lucifer, the existence of which seems clearly to indicate that the two primary layers of arthropods are identical with those of vertebrates.

An attempt was also made by the present writer to show that Dr. Gaskell's interpretation of the lateral and pineal eyes of vertebrates as the homologues of the lateral and median eyes of arthropods would not bear the test of critical examination. The same speaker endeavoured to explain the hollow tubular character of the vertebrate central nervous system as a comparatively recent adaptation to the requirements of the vertebrate organisation, in which the necessary increase of surface is brought about by the familiar process of folding. Dr. Chalmers Mitchell directed attention to the mode of origin of the nervous system in various invertebrate groups, and scored a point against Dr. Gaskell by his reference to the recent conclusions of Prof. C. Judson Herrick with regard to the arthropodan nervous system.

Prof. Starling maintained that, as regards the principles which must guide any research into the phylogeny of our race, a physiologist has as good a right to be heard as a comparative anatomist, and he thinks that "it is as difficult to conceive that the vertebrate was evolved from a primitive worm-like organism which shot up past the more highly developed Arthropoda as it is to believe that mankind is destined to be replaced by some beast that is now being evolved from lower groups in the depths of the sea." The observations of Dr. Smith Woodward, on the other hand, which dealt with the subject from the palæontological point of view, seemed to indicate that the process of evolution takes place very much in the way which Prof. Starling finds it so difficult to imagine. Moreover, the claims of the ancient ostracoderms to arthropodan affinities, upon which Dr. Gaskell lays so much stress, seem to be extremely dubious; they were probably highly specialised forms, perhaps related in some respects to the lampreys.

Though unable to accept his views on the subject before the meeting, Sir Ray Lankester voiced what must have been a very general feeling amongst those present in expressing his appreciation of Dr. Gaskell's observations.

ARTHUR DENDY.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor gives notice that the Sadlerian professorship of pure mathematics is vacant. The election to the professorship will take place on Monday, February 28. Candidates are requested to send their names to the Vice-Chancellor on or before Saturday, February 19.

The office of superintendent of the museum of zoology is vacant by the resignation of Prof. Punnett. The stipend at present attached to the office is 200*l*. per annum. Applications should be sent to the chairman of the special board for biology and geology (Prof. Langley, The Museums, Cambridge) on or before March 7.

Mr. J. C. F. Fryer has been elected to the Balfour studentship from March 25.

A grant of 200*l*. has been made from the Balfour fund to Mr. C. F. Cooper, for an investigation into the Tertiary vertebrate fauna of India, and a grant of 40*l*. to Mr. K. R. Lewin, in furtherance of his work in protozoology to be carried on abroad.

The following grants were made in the year 1909 from the income of the Gordon Wigan fund at the disposal of the special board for biology and geology:—(*a*) 12*l.* 10*s.* to Dr. D. Sharp; (*b*) 50*l.* to Prof. Langley, for the purchase of a Sändstrom kymograph and accessory apparatus; (*c*) 50*l.* to Mr. A. G. Tansley, that the botanic garden syndicate may continue to offer facilities for plant-breeding experiments; (*d*) 50*l.* to Mr. H. Scott, for the care and development of the collection of insects; (*e*) 25*l.* to Mr. H. H. Thomas, for collecting fossil plants in east Yorkshire with the view of a thorough investigation of its Jurassic flora.

OXFORD.—Dr. Henry Wilde, F.R.S., has offered the University the sum of 600*l.* for the foundation of an annual lecture on astronomy and terrestrial magnetism, in honour and memory of Edmund Halley.

A DEPARTMENT of experimental biology has, says *Science*, been organised in the Rockefeller Institute. Prof. Jacques Loeb, of the University of California, has been elected head of the department.

THE total amount received and promised up to the present for the building and endowment fund of Bedford College (University of London) is 47,700*l.*; a further 12,300*l.* is required before the buildings can be begun.

THE twelfth annual dinner of the Central Technical College Old Students' Association will be held at the Trocadero Restaurant, Piccadilly, W., on Saturday, February 12. Among the guests will be Sir Philip Magnus, M.P.

IT is announced in *Science* that the late Mr. D. Ogden Mills, of New York City, bequeathed 20,000*l.* to the American Museum of Natural History, 10,000*l.* to the New York Botanical Garden, and 5000*l.* to the American Geographical Society of New York City. From the same source we learn that Mr. J. S. Huyler, of New York, has given 4000*l.* to Syracuse University.

IN the Journal of the Royal Statistical Society for January Dr. W. Garnett discusses briefly the statistics of certain scholarship examinations of the London County Council. Returns of marks were available for about 10,000 boys and 10,000 girls, in round numbers, in the subjects of arithmetic and English, and Dr. Garnett has drawn up diagrams and formed models illustrating the correlation between the marks in the two subjects for each sex. Some interesting points are brought out very clearly in quite an elementary way, the distributions of frequency in the two cases presenting some conspicuous differences as well as some general similarities. In both sexes, for example, the weaker candidates on the whole did better in English than in arithmetic, and the stronger candidates better in arithmetic than in English; but while boys gaining more than half-marks on the entire examination began to do better as a whole in arithmetic than in English, the same could only be said of the girls attaining 67 per cent. of the total marks or more, *i.e.* it was only the comparatively exceptional girls who did the better in arithmetic.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 3.—Sir Archibald Geikie, K.C.B., president, in the chair.—F. D. **Thompson**: The thyroid and parathyroid glands throughout vertebrates.—Prof. E. A. **Minchin** and J. D. **Thomson**: The transmission of *Trypanosoma lewisi* by the rat-flea (*Ceratophyllus fasciatus*). The experiments that form the subject of this communication are concerned essentially with the *method* of transmission and with questions connected therewith. Incidentally, the *fact* of transmission is confirmed. All experiments were arranged so as to eliminate the possibility of infection other than by fleas, and to separate "direct" from "cyclical" infection. When preliminary experiments showed that infection, not "direct," had taken place, further experiments were arranged to determine if fleas once infective retain infection so as to be capable of infecting a series of healthy clean rats without themselves being again exposed to infection, and at the same time to determine by direct observation and within narrow limits (1) the length of the incubation period in the flea, and (2) the length of the multiplication period in the rat. In all the experiments tame rats and fleas bred in captivity were used. The general arrangements and a detailed account of each experiment are given, but cannot be summarised briefly. A few observations on fleas dissected are recorded, and reference is made to Nuttall's experiments and conclusions. The following conclusions are drawn from the results of the experiments:—(1) The rat-flea (*Ceratophyllus fasciatus*) transmits *T. lewisi* from infected to non-infected rats. (2) Transmission takes place by the "cyclical" method. (3) Transmission by the "direct" method did not take place. (4) The incubation period in the flea has a minimum length of about six days, but may be longer. (5) The length of the multiplication period in the rat is about twelve days. (6) In the developmental cycle the establishment of the trypanosome in the flea begins with multiplication of Crithidia-like forms in the rectum. No flagellates have been found by the authors in any fleas which had not fed on infected rats.—Dr. F. **Medigreceanu** (Bucharest): The relative sizes of the organs of rats and mice bearing malignant new growths. The effects have been determined for rats and mice of the growth of transplanted carcinomata and sarcomata upon the weights of the principal organs of the body. The weights of the different organs of normal animals bear a relatively constant ratio to the total weight of the body. Weighing experiments on 200 mice and rats bearing transplanted tumours, and on four mice with spontaneous tumours, have shown (1) no disturbance of the normal ratio for the alimentary canal; (2) hypertrophy of the liver in all cases, and up to a certain point proportional to the weight of tumour; (3) hypertrophy of the heart, also in proportion to size of tumour; (4) no disturbance of normal ratio for the kidneys except in the case of a spindle-celled sarcoma, which induced hypertrophy; (5) varying ratios for the lungs. The most important result has been the discovery of an enlargement of the liver in animals bearing carcinomata and sarcomata, whether transplanted or naturally arising.—Dr. E. F. **Bashford** and Dr. B. R. G. **Russell**: Further evidence on the homogeneity of the resistance to the implantation of malignant new growths. The principal object of the paper is to adduce further evidence that the resistance which animals already bearing transplanted tumours may offer to a second transplantation is identical in nature with the resistance offered by animals without tumours, after immunisation with normal or tumour tissue of the same species. A study of the processes at the site of the second implantation shows that, concomitantly with the establishment of the tumour developing from the first inoculation, an active resistance may be induced by the absorption of tumour tissue. Then the cancer cells implanted at the second inoculation fail to elicit the supporting connective tissue and vascular scaffolding necessary to their development into a tumour, and the process of resistance is exactly analogous to that previously described, when tumour tissue is implanted into mice after a preliminary immunisation with tumour or normal tissue of the same species. The assumption of a distinct form of resistance, "atreptic immunity," is thereby rendered superfluous when tumour-bearing animals are resistant to a second inoculation. Prevailing conceptions of what constitutes immunity to cancer *sensu strictiori* are simplified further by experiments demonstrating that the active immunity to cancer which follows in rats after a preliminary inoculation of mouse cancer is not an immunity against cancer, but against the protein of a foreign species. Therefore hypotheses of cancer immunity, based upon a study of the behaviour of tumours in strange species, have at most only an indirect bearing upon the immunity to cancer of the same species. By actual observation of the processes occurring in animals immunised against the inoculation of cancer of their own species, only one form of induced resistance has been demonstrated to exist, consisting, so far as elucidated, in an inhibition of the chemiotactic powers the cancer cells normally exercise upon the connective tissue and vascular scaffolding of the host. This single explanation harmonises all the observed facts and rids the experimental study of cancer both of confusing hypotheses and of errors.—Dr. M. **Haaland**: The contrast in the reactions to the implantation of cancer after the inoculation of living and mechanically disintegrated cells. Inoculation of living tumour of normal tissue of the same species has been shown to induce resistance to subsequent transplantation of cancer. The present paper records experiments in which cancerous or normal tissues, after mechanical disintegration at −180° or 0° C., have been inoculated into mice. The experiments show that a complete disintegration of the cells entirely robs them of their immunising properties against a subsequent transplantation of cancer. There is no difference between tumour cells and normal cells in this respect. The absence of immunising power does not seem to be a question of dose of introduced material, because relatively enormous doses of dead material do not induce any resistance. In the same way the press-fluid, obtained from tumours and normal tissues by Buchner's press, is devoid of immunising properties. The immunising property is not bound up with the protein of the cell, but depends on a different principle. Living cells are necessary to induce resistance to transplantation of cancer. It seems necessary that these cells must not only remain alive, but also even grow for a certain time; without the fulfilment of these conditions the reaction inducing active resistance is not set up. The same consequences follow autolysis, the action of heat, radium, &c., upon tumour tissue and normal tissue. The reaction which the introduction of disintegrated cells calls forth is not only quantitatively different from that induced by living tissues, but also qualitatively different. Far from inducing any increased resistance, inoculation of disintegrated cells only seems to manure the soil for a subsequent growth of tumours. The failure to elicit the reactions of immunity to the transplantation of cancer by devitalised tissues reveals an important difference from the immunity reactions obtained against bacteria and their products and foreign proteids in general, in which cases the immunising properties are independent of the vitality of the organisms or cells.

Royal Microscopical Society, January 19.—Sir E. Ray Lankester, F.R.S., president, in the chair.—The **President** gave the annual address, in the course of which he referred to such work as he thought could be carried out by the fellows with reference to the action of light upon protoplasm, the differentiation and specific effects of α, β, and γ rays emanating from radium, and the part actually played by bacteria in the processes of digestion. Medical science wanted their assistance in these investigations, which he thought could be, in some directions, better followed up by naturalists than by physiologists. Attention was also directed to an organism (*Clathrocystis aeruginosa*) found by Henfrey in 1852, in a pond in Kew Gardens, and so named by him, as worthy of their attention.

Institution of Mining and Metallurgy, January 20.—Mr. Edgar Taylor, president, in the chair.—A. L. **Simon**: Copper leaching plant in the Ural Mountains. A resumed discussion on this paper, which deals with the plant at the Gumeshevsky Copper Mine. The paper contained figures dealing with the installation and the cost of production, and a detailed description of the plant installed and the methods employed in operating it.—A. T. **French**: Some analyses of copper blast-furnace slags and determination of their melting points. The author gives tabulated results of a series of experiments, from which he deduces that slags may vary in composition to a considerable extent with very little change in the melting point.—Bede **Collingridge**: Errors due to the presence of potassium iodide in testing cyanide solutions for protective alkalinity.—A. R. **Andrews**: The detection of minute traces of gold in country rock.

Challenger Society, January 26.—Sir John Murray in the chair.—L. W. **Byrne**: A remarkable fish, apparently a new generic type, belonging to the family Stomiatidæ, taken from a trawl lowered to 700 fathoms off south-west Ireland.—James **Murray**: Life under Antarctic conditions. Sketching the difficulties of zoological research at high latitudes, the author described some unsuccessful experiments as a guide to fellow-workers. Between tide-marks no marine animals were found, the lower limit of this barren zone being the average depth of one year's ice; below that were always animals, protected by the ice, and living under singularly unvarying conditions. The land was extremely barren; the vegetation consisted of dwarfed mosses and lichens; the microscopic animals were rotifers, tardigrades, &c., which are permanently frozen through the ten months of winter, and in the summer thaw by day and freeze by night. The smaller ponds, which sometimes reached 60° F. in the summer owing to melted snow flowing over warm rocks, contained very little plankton, blue-green algæ, bacteria, and infusoria; the rotifers, &c., were found at the bottom on a plant of which nothing is known, perhaps lichenous in nature. The larger lakes were not melted through in three summers; a few animals were, however, obtained by boring. The rotifers lived under normal conditions at anything between 60° and −4° F.; they survived under experiment the temperatures of boiling water on the one hand, and on the other of a mixture of solid CO_2 and alcohol of about −172° F. While these fresh-water forms can bear such enormous temperature differences, the marine animals died if heated or cooled to a few degrees from their normal.

DUBLIN.

Royal Dublin Society, January 25.—Prof. J. A. McClelland, F.R.S., in the chair.—Prof. S. **Young**: The vapour pressures, specific volumes, heats of vaporisation, and critical constants of thirty pure substances. The determination of the vapour pressures, specific volumes, and critical constants of a number of pure liquids was commenced in 1888 in order to test the validity of the generalisations of Van der Waals regarding "corresponding" temperatures, pressures, and volumes. The data have been published at various times in several scientific journals. New or improved methods of experiment or calculation have been devised or adopted in the course of the work, and some of the data have required correction from time to time; it happens, consequently, that complete data for any one substance are not to be found in a single paper. The whole of the data, including the values obtained before 1888 by Ramsay and Young for ethyl ether, three alcohols, and acetic acid (up to 280°), have now been revised and collected, and are tabulated in this paper, which also contains a brief account of the methods of preparation and purification of the thirty liquids, and a description of the apparatus and methods employed for the determination of the physical constants. The heats of vaporisation have been calculated by Dr. J. E. Mills by means of the Clapeyron-Clausius formula, and he has very kindly supplied the data. The author is also indebted to Dr. Mills for some of the other calculated data.—Prof. J. **Wilson**: The inheritance of coat colour in horses. Having stated that Mr. C. C. Hurst had already shown (Proc. Royal Society, vol. lxxvii., 1906) chestnut to be recessive to bay and brown—the two taken as one—the author proceeded to show where some other colours fit in. Much uncertainty exists among breeders in distinguishing bay from brown, and dark brown from black. Allowing for this, the five main colours form a series in which those towards one end are recessive to all towards the other. Chestnut is recessive to black, bay, brown, and grey; black to bay, brown, and grey; bay to brown (probably) and grey; and brown to grey. The position of two other colours can be fixed only approximately, for want of sufficient data. Dun is dominant to all to the left of brown, that is, to chestnut, black, bay, and brown. Roan is also dominant to chestnut, black, bay, and brown, and perhaps also to dun and grey; but it has this peculiarity, that the roan does not blot out the other colours, but the white hairs of the roan mingle with coats of the other colours. This implies that there are chestnut roans, bay roans, and so on.

PARIS.

Academy of Sciences, January 24.—M. Émile Picard in the chair.—Ch. **André**: The Johannesburg comet. This was seen by M. Guillaume on January 21. It was very brilliant, its nucleus having a brightness a little greater than that of Arcturus.—Alfred **Grandidier**: The international map of the earth on the scale of 1/1,000,000. At the Geographical Congress held at Vienna in 1891 Prof. Penck suggested the production of a uniform map of the earth on the scale of 1 in 1,000,000, and an account is given in the present paper of the progress that has been made with this map, and the difficulties owing to lack of uniformity in the conventional signs employed. The total cost of this work is estimated at 5,000,000 francs.—E. **Esclangon**: Observation of Drake's comet. A description of the appearance of the Johannesburg comet on January 22 at Bordeaux.—H. **Bourget**: Observations of Drake's comet (1910*a*) made at the Observatory of Marseilles. Positions of the comet are given for January 19, 20, and 21.—Remarks by M. **Baillaud** on this paper, giving an account of other dates and places in France where observations of the comet had been made.—E. **Maubant**: The elements of Tempel's comet.—J. **Le Roux**: The conditions of maximum or minimum of an analytical function with an infinity of variables.—D. **Mirimanoff**: The last theorem of Fermat.—M. **Galbrun**: The representation of the solutions of a linear equation of finite differences for large values of the variable.—Paul **Helbronner**: The connections of the meridian chain of Savoy with the fundamental Italian and Swiss triangulation.—Edm. **van Aubel**: Pulfrich's relation between the volume contraction and the refractive power of mixed liquids. A discussion of the experimental data of R. Wintgen on the density and refractive indices of solutions of salts and acids from the point of view of the formula of Pulfrich.—P. **Vaillant**: The laws of evaporation. In the apparatus devised by the author the quantity of liquid evaporated per second is independent of the nature of the liquid, depending only on the area of the opening through which the vapour of the liquid escapes. An examination of numerous liquids led to the relation $q=a\mathrm{MF}^{\frac{4}{3}}$, in which q is the rate of evaporation per second, F the maximum vapour pressures of the liquids at the temperature of the experiments (20° C.), and a an approximate constant. To fall into line with the other liquids, it is necessary to attribute the molecular weight $(H_2O)_3$ to water.—C. **Féry**: Prisms with curved faces applicable to spectroscopy. The object of the arrangement described and figured is to reduce the spectroscope to the slit, prism and ocular, or photographic plate. The arrangement possesses advantages in stellar spectroscopy.—Gaston **Gaillard**: Observation of a dissymmetry in the velocity of solution of crystals of sugar along the different faces.—J. **Chaudier** and Ed. **Chauvenet**: The radio-activity of the halogen and oxyhalogen compounds of thorium. The radio-activity of these compounds of thorium for quantities of substance containing more than 10 milligrams of thorium varies with the nature of the associated elements. The intensity of the radiation diminishes as the atomic weight of these elements increases. The curves of radio-activity of the various compounds of thorium tend towards that of thorium as the quantities of material are reduced.—Pierre **Camboulives**: The action of carbon tetrachloride vapours upon some minerals. Many natural oxides are attacked by the vapours of carbon tetrachloride as easily as the oxides prepared in the laboratory. Corundum offers an exception, being attacked only to the extent of 11 or 12 per cent., whilst alumina arising from the calcination of ammonia alum is completely transformed. Wolfram is so readily acted upon that the process forms the basis of a good analytical method. Silicates are the more readily acted upon the poorer they are in silica. Numerous examples are given.—F. **Kerforne**: An auriferous lode situated at Beslé (Loire-Inférieure). An account of some ancient gold workings.—Ch. **Moureu** and J. Ch. **Bongrand**: Carbon subnitride, C_4N_2. This substance, which is the second definite compound known of carbon and nitrogen, is formed by the removal of water from butine diamide, $NH_2—CO—C\equiv C—CO—NH_2$, and hence has the constitution $N\equiv C—C\equiv C—C\equiv N$, or dicyanacetylene. It forms fine white needles, melting at 21° C. and boiling at 76° C. under a pressure of 753 mm. Its vapour is violently irritating, and catches fire in the air at a temperature of about 130° C. Particulars are given of the analysis, determination of the vapour density and molecular refraction, and further work is being carried out on its physical and chemical properties.—Maurice **Lombard**: The chemical and biological effects of the ultraviolet rays. The formation of nitrites in these experiments is definitely proved.—Gabriel **Bertrand** and M. **Holderer**: New observations on the individuality of cellase. Details of experiments proving that cellase is a specific diastase. It is found, more or less mixed with other species of diastases, in barley, almonds, the mycelium of *Aspergillus niger*, &c.—M. **Marage**: The photography of the voice in practical medicine. The photography of the vibrations of the larynx shows very clearly the state of the voice at the beginning and end of a course of treatment. Its use as an aid to diagnosis is being further examined.—A. **Rosenstiehl**: The consequences of Young's hypothesis. The sensation of binary white.—P. **Hachet-Souplet**: The association of sensations in animals. The law of recurrence.—A. **Lécaillon**: The structure and signification of the membrane which envelops the vitelline sphere in the egg of birds.—Léon W. **Collet**: The presence of fossil-bearing Cenomanian in the limestone Alps of Haute Savoie.—E. **de Martonne**: The genesis of Alpine glacial forms.—Kr. **Birkeland**: The magnetic deviability of the corpuscular radiations proceeding from the sun.—Alfred **Angot**: The earthquake of January 22, 1910. The seismograph of the Parc Saint-Maur Observatory recorded a distant earthquake of great violence on January 22. The examination of the seismograms showed that the epicentre was about 3000 kilometres to the south-east. Observations from other stations are required to fix the direction with certainty.—Bernard **Brunhes**: The record of an earthquake on January 22, 1910, at the Puy de Dôme Observatory. The seismograms indicated 3000 to 3500 kilometres as the distance of the epicentre.

January 31.—M. Emile Picard in the chair.—H. **Deslandres,** A. **Bernard,** and L. **d'Azambuja**: First observations of Drake's comet at the Observatory of Meudon. Spectroscopic observations were possible on January 22, 24, 25, 27, 29, and 30. Changes in the comet's spectrum were observed during these days. At first the sodium line was the most marked, together with a faint hydrocarbon band. The strength of the sodium line diminished from day to day, the hydrocarbon bands increasing in clearness and the bands of cyanogen appearing. On the last two days the sodium line became invisible, but the spectra of the hydrocarbons and cyanogen became complete and intense. The spectrum of the hydrocarbons even appeared to extend a considerable distance into the tail. These changes are exactly those undergone by the large comet of 1882.—B. **Baillaud**: The photographic map of the sky. Presentation of the proceedings of the last congress.—A. **Muntz**: The mud carried away by the waters of the Seine. Determination of the amount of mud in suspension in the Seine shows that the total amount carried away by the river between January 25 and 29 varied from 18,800 to 11,000 tons per day. This is not regarded as causing a serious loss of fertility in the soil from which this mud has been removed.—Edmond **Perrin** gave an account of the state of the museum after the floods.—Henri **Douville**: The discovery of the marine Trias at Madagascar.—M. **Giacobini**: Observations of the comet 1910*a* made at the Observatory of Paris with the 38-cm. equatorial. Positions are given for January 22, 24, 25, 27, 29, and 30.—P. **Chofardet**: Observations of the Johannesburg comet, 1910*a*, made at the Observatory of Besançon with the bent equatorial. Positions given for January 27 and 29.—Ch. **Lallemand**: A systematic error in the determination of the mean level of the sea by the medimaremeter. In this instrument, consisting of a tube closed at the lower end by a porous pot, the water-level oscillates round the mean sea-level. The systematic error now discovered is due to the removal of a few drops of water each time a tube is introduced to take the level. On this account the readings of the instrument are 1·5 mm. too low.—M. **Biquard**: A method of measuring the coefficient of thermal conductivity of badly conducting bodies. In the instrument described the heat is transmitted regularly through isothermal surfaces, the amount being measured by the rate of production of water from ice.—G. **Thovert**: Diffusion and the kinetic theory of solutions. An extension of the method previously described to solutions in methyl alcohol.—Ch. **Fabry**: The intrinsic brightness of the starry sky.—J. H. **Russenberger**: The absorption of liquids by porous substances.—F. **Laporte** and P. **de la Gorce**: Researches on the electrochemical equivalent of silver carried out at the Central Electrical Laboratory. Successive improvements introduced into the purification of the silver nitrate used in these experiments have resulted in the removal of the difference of 0·0004 originally found between the determinations of the National Physical Laboratory and those made at the Central Laboratory in Paris. The general mean of the results is 1·11829 mgr. silver per coulomb.—G. **Fouquet**: The spontaneous crystallisation of sugar.—M. **Oberreit**: The synthesis of 5 : 7 : 5′ : 7′-tetrachlorindigo.—[illegible] **Yvon**: Aniline emetic. This is prepared by the inter[illegible]ion of oxide of antimony and the acid tartrate of [illegible] Figures are given for its density, rotatory power, [illegible]bility, and crystalline form.—Maurice **Holderer**: The influence of the reaction of the medium on the filtration of some malt diastases.—H. **Agulhon**: The use of boron as a catalytic manure. From the experiments described it is concluded that boron is an element of use to the higher plants. The addition of a small quantity of boron (in the form of boric acid) to a culture medium or to a natural soil leads to a sensible increase in the weight of dry material formed.—André **Brochet**: The radio-activity of some springs in the Vosges.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 10.

ROYAL SOCIETY, at 4.30.—Some Phenomena of Magnetic Disturbances at Kew: Dr. C. Chree, F.R.S.—On a Novel Phenomenon in the Diurnal Inequality of Terrestrial Magnetism at Certain Stations: R. B. Sangster.—The Absorption Spectra of Vapours of the Alkali Metals: Prof. P. V. Bevan.—On the Shapes of the Isogeotherms under Mountain Ranges in Radio-active Districts: Prof. C. H. Lees, F.R.S.—On the Propagation of a Disturbance in a Fluid under Gravity: F. B. Pidduck.—On the Flow of Water through Pipes and Passages having Converging or Diverging Boundaries: Dr. A. H. Gibson.—The Effect of Pressure upon Arc Spectra: Titanium: R. Rossi.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Losses off Transmission Lines due to Brush Discharge, with Special Reference to the Case of Direct Currents: E. A. Watson.

MATHEMATICAL SOCIETY, at 5.30.—A Note on Double-sixers of Lines: H. W. Richmond.—On the Diffraction of a Solitary Wave: Prof. H. Lamb.—Notes on Various Points in the Theory of Functions: Dr. H. F. Baker.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Waves in Water, Sand, and Snow: Dr. Vaughan Cornish.

FRIDAY, FEBRUARY 11.

ROYAL INSTITUTION, at 9.—Electrical and other Properties of Sand: C. E. S. Phillips.

PHYSICAL SOCIETY, at 8.—Annual General Meeting. President's Address.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

MALACOLOGICAL SOCIETY, at 8.—Unio, Margaritana, Pseudanodonta, and their Occurrence in the Thames Valley: Fritz Haas.—(1) Pleistocene, Holocene, and recent Non-marine Mollusca from Mallorca; (2) Marine Mollusca from Alcudia, Mallorca: Rev. R. Ashington Bullen.—Description of a New Species of Vivipara from New Guinea: H. B. Preston.—Description of a New Species of Unio from the English Wealden Formation: R. Bullen Newton.

SATURDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

MONDAY, FEBRUARY 14.

ROYAL SOCIETY OF ARTS, at 8.—The Petrol Motor: Prof. W. Watson, F.R.S.

TUESDAY, FEBRUARY 15.

ROYAL INSTITUTION, at 3.—The Emotions and their Expression: Prof. F. W. Mott, F.R.S.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Glare, its Causes and Effects: Dr. J. H. Parsons.

ZOOLOGICAL SOCIETY, at 8.30.—Kinematograph Demonstration (Studies in the Society's Gardens): Charles Urban.—Additions to our Knowledge of the Fossorial Wasps of Australia: R. E. Turner.—Descriptions of New Lycænidæ and Hesperiidæ from Tropical West Africa: H. H. Druce.—On certain Subcutaneous Fat-bodies in Toads of the Genus Bufo: C. L. Boulenger.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Notes on the Sheffield Water-supply and Statistics relating thereto: L. S. M. Marsh.—Statistical and Experimental Data on Filtration: W. R. Baldwin-Wiseman.

ROYAL STATISTICAL SOCIETY, at 5.

WEDNESDAY, FEBRUARY 16.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Notes on *Dendrobrachia fallax*, Brook, a Rare and Divergent Antipatharian: Prof. J. Arthur Thomson.—(1) On the Measurement of the First Nine Groups of Grayson's Finest Twelve-band Plate; (2) On the Measurement of the Diameter of the Flagella of the Cholera Bacillus prepared by Löffler's Method: A. A. C. Eliot Merlin.

ROYAL SOCIETY OF ARTS, at 8.—The Lifeboat and its Work: Sir John C. Lamb, C.B., C.M.G.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1909: E. Mawley.—The North Atlantic Anticyclone. Tracks of the Centres of High Areas 1882–3: Colonel H. E. Rawson, C.B.

THURSDAY, FEBRUARY 17.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Phosphorescence produced by α and β Rays: E. Marsden.—Theory of the Luminosity produced in Certain Substances by α Rays: Prof. E. Rutherford, F.R.S.—(1) The Scattering of the α Particles by Matter; (2) The Ionisation produced by an α Particle. Part II.: Connection between Ionisation and Absorption: Dr. H. Geiger.—The Influence of Pressure on the Boiling Points of Metals: H. C. Greenwood.—On the Viscosities of the Gases of the Argon Group: A. O. Rankine.

ROYAL INSTITUTION, at 3.—Illumination, Natural and Artificial (Experimentally Illustrated): Prof. S. P. Thompson, F.R.S.

LINNEAN SOCIETY, at 8.—The Plum-moths of the Seychelles Expedition: T. B. Fletcher, R.N.—Die von Herrn Hugh Scott, auf den Seychellen gesammelten Embiidinen, Coniopterygiden und Hemerobiideen: Dr. G. Enderlein.—Die Termiten der Seychellen-Region: Dr. Nils Hohngreen.—On the Land and Amphibious Decapoda of Aldabra: L. A. Borradaile.

ROYAL SOCIETY OF ARTS, at 4.30.—The Bombay Housing Question: G. O. W. Dunn.

INSTITUTION OF MINING AND METALLURGY, at 8.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Waves in Water, Sand, and Snow: Dr. Vaughan Cornish.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Head Hunters in Assam: T. C. Hodson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electric Clocks: F. Hope-Jones.

FRIDAY, FEBRUARY 18.

ROYAL INSTITUTION, at 9.—Halley's Comet: Prof. H. H. Turner, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—*Further discussion*: Ninth Report to the Alloys Research Committee: On the Properties of some Alloys of Copper, Aluminium, and Manganese (with an Appendix on the Corrosion of Alloys of Copper and Aluminium when Exposed to the Sea): Dr. W. Rosenhain and F. C. A. H. Lantsberry.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Irrigation Works: Sir R. Hanbury Brown, K.C.M.G.

SATURDAY, FEBRUARY 19.

ROYAL INSTITUTION, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

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THURSDAY, FEBRUARY 17, 1910.

ASEPTIC SURGERY.

The Collected Papers of Joseph, Baron Lister. Two vols. Vol. i., pp. xliv+429; vol. ii., pp. vii+589. (Oxford: Clarendon Press, 1909.) Price 2*l.* 2*s.* net.

ALTHOUGH the numerous papers collected in these two volumes were for the most part written thirty or forty years ago, their interest is in no way diminished to-day. Had the work of Lister failed to meet with due appreciation, his friends and pupils could have found no surer way of obtaining this than by the simple collection of his writings into these two volumes, and when one has said "this was his work," no further comment or eulogium is possible. In the records of most epoch-making discoveries one can read between the lines the character of the discoverer. At first sight it would seem as if the papers dealt with many and diverse subjects, but more careful study shows a remarkable unity, each one constituting a step towards the great work with which the name of Lister will always be associated.

With the exception of one or two isolated physiological papers, Lister's work was directed towards the elucidation of the meaning of the phenomena, which followed injuries to living organisms, commonly summed up under the term inflammation. Lister carried out a long series of experiments on the coagulation of blood, which must ever remain as a pattern of carefully planned and skilfully worked out investigation; and it was the relationship between inflammation and vascular thrombosis which determined the point from which he attacked this problem.

Lister's observations had for their object the study of blood coagulation in the vessels themselves, and he attempted to discover why blood which coagulated so readily when shed into a basin remained fluid in contact with living or surviving tissues. His experiments upon inflamed blood-vessels, conducted largely upon the web of a frog's foot, in spite of the large amount of work which has been done on this subject, require but little revision; his experiments on the pigmentary corpuscles in the frog form one of the most brilliant demonstrations of the effect of injury on the tissue cells as distinguished from changes in the blood-vessels.

Naturally, however, the greatest interest of Lister's work centres around the papers on the use of antiseptics. Surgery was not merely revolutionised—a new science was born. His article on "A New Method of Treating Compound Fracture, Abscess, &c., with Observations on the Conditions of Suppuration," gave the result of two years' experience in the new methods. This paper was published in 1867, and reading it to-day it is difficult to conceive why theories so ably argued and so conclusively proved failed to obtain immediate acceptance; but for many years Lister shared the common fate of reformers, and had to cope with misunderstanding and misrepresentation. It is appalling to think that in the great war of 1870 and 1871 no real attempt was made to use the methods which Lister had employed for four years. The opposition, however, to Lister's methods was not unique, for in the article on anæsthetics in these volumes, written in 1861, seventeen years after the discovery of ether, Lister remarks

> "that such being the great benefits conferred by this agent it is melancholy to reflect that in many parts of Europe and even of the United Kingdom it is either withheld altogether or given so scantily as to be nearly useless."

The "sepsis" which Lister was attacking was not the sepsis which is known to-day, but actual putrefaction of the discharges from wounds, to which were attributed the septicæmia, pyæmia, and hospital gangrene which were so prevalent before the antiseptic era. It is hard to-day to think of being familiar with

> "the faint sickly smell commonly perceptible in surgical wards under ordinary treatment, and still more with the stench which prevails at the time of the daily dressing";

but at that time it was a matter of common experience. The value of the antiseptic method could not have been more severely tested than in the original men's accident ward in Glasgow Infirmary, in which it was first put in practice. Separated from this ward by a passage 12 feet wide was another similar ward, in which the death-rate from pyæmia and hospital gangrene was so high that it attracted the attention of the authorities even at this time. An excavation was made, and it was found that on a level with the floors of these two wards, with only the basement area, 4 feet wide, intervening, was the uppermost tier of a vast number of coffins, placed there during the cholera epidemic of 1849. In addition to this, one end of the surgical hospital abutted on the cathedral burial yard, in which the revolting practice of pit burial was carried out; that is to say, bodies of paupers enclosed in rough coffins were placed in large pits, which were loosely covered up with boards, and only filled in with earth when the pit was full. In such circumstances as these, Lister was able to state, at the British Medical Association meeting in Dublin, that for the nine months in which the antiseptic system had been in proper working order not a single case of pyæmia, erysipelas, or hospital gangrene had occurred in his ward, although these diseases were exceptionally rife in the other wards of the hospital.

In the first attempts at antiseptic surgery, German creosote, a crude form of carbolic acid, was introduced into the wound on a strip of lint, which was in some cases left in position; some fresh antiseptic was mixed with the blood exuding from the wound so as to form a crust, the carbolic acid in which was then prevented from evaporating by a piece of block tin; this was removed once or twice a day, and fresh carbolic acid painted on the crust to supply the place of that which had evaporated. Crude and irritating as this method was, its results were an enormous improvement on any that had been previously obtained. Of the first eleven cases of compound fracture and dislocation treated in this way only one died, although at this time recoveries were extremely rare, and the accident was regarded as one of the most dangerous known to surgeons.

Carbolic acid was first brought to Lister's notice by reading accounts of its deodorising action upon the sewage of Carlisle, and it is interesting to note that this, the first substance used by Lister in his antiseptic method, still retains its pre-eminence as an all-round antiseptic.

These first methods were only a beginning, and throughout the whole course of his active life Lister busied himself in perfecting his method, striving to find means whereby asepsis could be secured with a minimum irritation of tissues, without deviating in the slightest degree from those scientific principles which had guided him at the outset of his work.

The conquest of suppuration not only perfected older operations, but opened the way for new ones, and Lister himself introduced a large number of these. Joints, interference with which had been looked upon as utterly unjustifiable, were opened with impunity, fractures with vicious union were exposed and rectified, new principles in amputation introduced, and the use of the aseptic ligature, by obviating the risks of hæmorrhage, removed one of the greatest dangers of surgery.

Not the least interesting of the papers collected in these volumes is that on anæsthetics, a subject to which Lister devoted a considerable amount of attention, and in view of the recently proposed legislation it is interesting to note that Lister strongly disapproved of specialists in this branch of practice, holding that the administration of an anæsthetic called for care rather than for special skill and experience.

Lister in all his writings frankly and gratefully acknowledged and appreciated the work of others, especially Pasteur, and that "hard-worked general practitioner," Koch. His work is its own monument; it has given modern surgery to mankind, and so simplified its performance that operations can be performed without any particular comment which fifty years ago would have left the whole world aghast at their daring.

A NATURALIST IN ECUADOR.

Nel Darien e nell' Ecuador. Diario di viaggio di un Naturalista. By Dr. E. Festa. Pp. xvi+397. (Torino: Unione Tip.-Editrice Torinese, 1909.) Price 10 lire.

DR. E. FESTA'S main object was the zoological exploration of Ecuador. However, as the isthmus of Darien or Panama lies on the way to Ecuador, and since this interesting country happened to pass through one of its revolutions, he spent the time from the months of May to September, 1895, on the isthmus, chiefly among the intricate inlets of the Gulf of San Miguel, on the Pacific side, extending thereby his collecting over every class of the animal kingdom, from sponges to mammals.

After the political conditions had become a little more settled, he went to Ecuador in September, 1895, and stayed there to April, 1898. Entering the country by Guayaquil, he travelled east to Cuenca and beyond, to the headwaters of the Rio Santiago of the Marañon system, and northwards by Quito to Julian, near the frontier of Colombia. His travels, extending, roughly speaking, from 4° latitude south to 1° north, and between 80° to 78° longitude west, cover only a small part of the vast country of Ecuador, but he explored it thoroughly.

He was much indebted to the President of the Republic; for instance, on the strength of his official credentials the local authorities occasionally commandeered porters and mules. Above all, he was helped by the missions of the Società Salesiana de Torino, and he had the inestimable advantage of being accompanied on his perilous excursions through the forests of the Santiago district by a former compatriot, Sr. G. Pancheri. An agreeable feature was the hospitality offered by many Ecuadorean owners of haziendas. About 500 specimens of mammals, more than 3000 birds, 150 different kinds of reptiles and amphibians, as many kinds of fishes, and ever so many invertebrates, were brought together and given to the Royal Museum at Turin. They testify to the richness of the fauna, and last, not least, to the enormous labours of Dr. Festa and the Italian collector whom he was able to take with him. However, they took whatever kind they could, and of every kind as many specimens as possible. For instance, no fewer than nine condors were shot at one spot, and in typically national style the travellers spread nets in forest and garden, and gloated over the numbers of little beauties ensnared. The step thence to that pest, the plume-hunter, seems but small; at least, it is a bad example to the natives.

Naturally our author experienced many ups and downs, but he had no hairbreadth escapes, as such are now of rare occurrence to veracious travellers. Already in the mangrove swamps of Darien he suffered much from fever and severe gastric troubles, and camp life was often utterly spoiled by the pests of insects. It was not only the stinging, poisonous kinds, but a great aggravation were the stingless bees, Melipone, big and small, which in their numbers insinuated themselves into the hair, mouth, nose, and ears. To make work possible, the traveller had to put smouldering branches upon the table. Some kind of Oestrus stung Dr. Festa in the abdomen, causing several months of torment, and after opening the swelling he extracted a fat maggot, four centimetres in length. The horses suffered indirectly from the bites of the blood-sucking bats, Desmodus, because flies deposited their eggs in the little wounds, and the maggots caused enormous ulcers. Sand-fleas, *Sarcopsylla penetrans*, were a plague in many places, and every specimen of digging rodents had its feet infested with them.

Several specimens of the Andine bear, *Tremarctos ornatus*, were procured. This creature, preferring to travel in comfort, prepares its bed on the ground, by covering a space about a yard in diameter with branches and twigs to lie upon during the night.

After having found such "beds," the travellers came across a family of bears, which had their lair at the foot of a tree, hidden by dense foliage. When dislodged, some of them climbed about rapidly.

The beautiful Morpho butterflies were abundant at places, and not at all shy. On the contrary, they alighted upon the table and sucked from the dishes during breakfast. At Cuenca Dr. Festa was treated to the spectacle of a fierce battle, which lasted all day long, and on the following day the victor entered the town after a loss of 900 dead. A rather full and interesting account is given of the Iivaros tribe of Indians, who, not yet appreciating the value of money, required knives, guns, needle and thread, &c., for barter. The wilder they were, the better they were as collectors. Their special weapon is the blowpipe. A favourite ornament of both sexes, besides painting themselves, is a wooden lip-plug, one inch long and half an inch thick, with pendants of needles, the brightly-coloured wings of beetles, &c. The house is large, of the type of the communal house, the sexes occupying different quarters of the same large room, and to each woman's bed are tied several fierce watchdogs.

In the mountains of the province of Carchi were procured a considerable number of antique specimens of pottery and some crania.

Unfortunately, this book is written mostly in the style of a diary, which does not well lend itself to generalisations, but rather to matter-of-fact records of animals and plants observed. It would have been interesting to read how the Ecuadorean civilisation appeared to an Italian, a cultured representative of another Latin race. The English-speaking civilisation is too divergent from the Latin-American in almost every walk of life really to understand it and to appreciate its many good points. However, the author is modest, and enlivens his account of the many things he has done and seen with but little humour.

The book, printed in excellent type and on very good paper, and adorned with some seventy or eighty, mostly full-paged, beautifully reproduced photographs, seems wonderfully cheap for the price of 8*s.*

AUSTRALIAN ANIMALS.

The Animals of Australia. Mammals, Reptiles, and Amphibians. By A. H. S. Lucas and W. H. Dudley le Souëf. Pp. xi+327. (Melbourne: Whitcombe and Tombs, Ltd., 1909.) Price 15*s.* net.

MESSRS. LUCAS AND LE SOUËF have given us a book which ought to find a very hearty welcome, especially amongst Australian naturalists. Whilst intended primarily for the general reader, the arrangement and treatment are throughout thoroughly scientific, and the illustrations, many of which are from original photographs, are, on the whole, very good. The full-page photograph of a wheelbarrow on p. 179 is perhaps a little superfluous, however. It is true that the wheelbarrow contains a snake, but it is a very small one, and a much better photograph of the same snake is given on another page.

The information that the number of Australian species of Eutheria is the same as that of the marsupials (106) comes rather as a surprise, even if, as we suppose, it includes introduced species.

The authors have a melancholy tale to tell of the rate at which the marsupials are being exterminated for the sake of their skins. It appears that no fewer than 873,837 "opossum" skins were offered for sale in the Sydney market alone during the year 1908, and other species in hardly less alarming numbers.

The section dealing with the snakes is one of the most interesting. Death from snake-bite appears to be rare in Australia, although many of the species are poisonous, and some of them deadly. In case of snake-bite, however, most people prefer to err on the safe side, though there are probably not many who have so much to show for their mistake as the man who exhibits to his friends a bottle containing one of his own fingers and a perfectly harmless snake by which it had been bitten! Snake-stories form an important part of the literature of the Australian bush, but we do not recollect having heard before about the tiger-snake which was found enjoying a sun-bath balanced on the topmost wire of a fence, with the folds of the body nicely adjusted on each side to maintain the balance. We are told that the Australian snakes do not charm or fascinate their prey in any way (p. 156). If this is so, we are at a loss to understand the photograph on p. 181, which, at first sight, at any rate, looks like a snake fascinating a hen; perhaps, however, the hen is refusing to be fascinated.

One difficulty which has to be overcome by the writer of a popular book on natural history in a "new" country is the absence of a popular terminology. To some extent Messrs. Lucas and le Souëf have endeavoured to supply this deficiency; notably in the case of the Agamid lizards, for which they suggest the name "Dragons." Thus *Amphibolurus maculatus* is to be known as the "Military Dragon," presumably on account of its brilliant colours; but we should hardly have thought that "Queen Adelaide's Dragon" was an appropriate rendering of *Amphibolurus adelaidensis*, the termination of the specific name suggesting a geographical rather than a personal reference. In a few cases the Australian public has already taken the matter of nomenclature into its own hands, as in the well-known case of "Goana," which is, of course, a corruption of "Iguana," a name popularly but erroneously applied to the "lace monitor" (*Varanus varius*).

Although the book does not profess to deal with the fishes, the authors have not been able to resist the temptation to include an account of Ceratodus, evidently on the ground that it is "part fish, part amphibian." The amphibian part seems hardly sufficient to justify its inclusion, but we must admit that the temptation was very strong.

The book is well got up, though the paper is unpleasantly glossy. We can strongly recommend it to all who are interested in Australian natural history.

MACHINE DESIGN.

Elements of Machine Design. By Dr. S. Kimball and J. H. Barr. Pp. viii+446. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 12*s.* 6*d.* net.

THIS is an important work on a subject which it is difficult to treat in systematic manner on account of the great complexity of the conditions involved. The variety of machines now made is almost overwhelming, and is continually increasing, while for the successful and intelligent design of machines of any one class the engineer must possess a faculty of invention, a sound judgment, some acquaintance with commercial conditions, familiarity with workshop processes, a knowledge of the many branches of applied mechanics and of physics, all the result of long study and practical experience. The treatment of so extensive a subject must of necessity be only partial, and the primary appeal of this book is to students of technical colleges. At the same time, the expert draughtsman will find much of interest and profit. The drawings are subordinate, and are introduced mainly to illustrate principles. The treatment is logical yet practical, very suggestive and germane to the subject, and the style is attractive and interesting. The writers can speak with authority, each having had experience as a professor of Sibley College, Cornell University, and also as a manager of an engineering works.

The authors begin with some examples illustrating the energy changes which take place in a machine during a cycle of operations, the object of the investigation being to determine the maximum value and range of the force actions which occur. Then follows an explanation of how the parts are to be designed so as to withstand successfully these straining actions, and a very complete and well-arranged collection of formulæ for the strength and stiffness of beams, shafts, struts, &c., is given. The discussion of the considerations which affect the choice of a suitable factor of safety will here be found very helpful.

The chapter on friction, lubrication, and efficiency is extremely interesting and suggestive. The investigations on lubrication by Beauchamp Tower and later experimentalists are quoted and analysed, and their significance explained. Subsequent chapters are devoted to machine details, comprising springs, riveted joints, screws and bolts, keys and cotters, tubes and pipes, constraining surfaces for sliding and turning motions, shafting and couplings, belt, rope, and chain transmission, friction wheels and brakes, spur, bevel and screw gears, flywheels, pulleys and rotating discs, and, lastly, machine frames.

The chapter on constraining surfaces is one of the best in the book. Some of its drawings exhibit modern types of cylindrical and thrust bearings, and ball and roller bearings. In the general discussion the authors enter fully into the permissible bearing pressures, the details for securing efficient lubrication, the dissipation of heat from the bearing, and all the conditions for successful design. Indeed, every chapter is suggestive and interesting, but enough has been said to indicate the general character and scope of the work. We must, however, not overlook the numerical examples which are introduced at intervals, and used to illustrate and suggest the proper treatment of problems in design. Mention should also be made of the many references to publications, to assist readers who desire further information.

Altogether, the authors are to be congratulated on the production of a very instructive, well-arranged, and well-written treatise on the elements and principles of machine design. The book should be in the library of every engineering school and college.

THE ATRIUM OF SOUTH AFRICA.

An Introduction to the Geology of Cape Colony. By Dr. A. W. Rogers and A. L. Du Toit. Second Edition. Pp. xiv+492. (London: Longmans, Green and Co., 1909.) Price 9*s.* net.

THIS handbook is the second edition of that reviewed in 1905, and the progress made since then in South African geology renders its appearance all the more welcome. Dr. Rogers has associated his colleague, Mr. Du Toit, in the authorship, and the preparation of the new material has no doubt raised pleasant memories of many a long campaign, in lands where the horizon always seems to call one further, until the rim of the world sweeps up against the sunset, and another night is spent beneath the stars.

The complete revision of the work makes it virtually a new one for purposes of reference; and the coloured map is now on a larger scale, and covers additional ground, notably in Griqualand West. Two sections illustrate the folded margins of the colony, and the broad synclinal of the Karroo system, which in places measures 450 miles from side to side. The correlation of the pre-Devonian rocks (p. 5) is considered in some detail, and reasons are given (p. 110) for the retention in this group of the "continental" Matsap system on the fringe of the Kalahari. The Karroo system, from the Lower Dwyka beds to the volcanic capping of the Drakensbergen, is compared (p. 233) with South American and European strata, on the basis of recent literature. The glacial Dwyka beds, composed of the so-called "tillite," may be Upper Carboniferous or Lower Permian; but the reptilian fauna places the Upper Dwyka series in the Permian. The Beaufort beds, with Pareiasaurus, Oudenodon, and the freshwater molluscs Palæomutela and Palæanodonta, are paralleled by the Russian Permian. The Upper Beaufort or Burghersdorp series is, however, probably Triassic; so also are the succeeding Molteno beds, regarded as equivalents of the Rhætic. The Stormberg series, if we except the Molteno beds, is held to be Jurassic. Dr. Broom has entirely re-written his chapter on the Karroo reptiles, and points out that Tritylodon, which he has elsewhere shown to be most probably a Jurassic form, may be retained among the mammals.

The chapter on the volcanic pipes younger than the volcanic Stormberg series has been expanded, but no longer contains the sections of the rock-shafts at Kimberley. The relationship of their igneous infilling, known as kimberlite, to melilite-basalt (p. 364) is emphasised by new evidence from North America, in addition to that known from Cape Colony. A brilliant suggestion of Carvill Lewis becomes thus fully justified.

In the fine chapter on the geological history of the colony, the influence of Prof. W. M. Davis (p. 451) now becomes justly manifest. There was little to modify, however, in Dr. Rogers's original review of the great processes that have made South Africa. His suggestion that the S-bends of the rocky gorges in the south are the descendants of meanders formed when the rivers ran over a great plain remains happily unaltered. If South African geologists have learnt willingly from friends whom they invited in 1905 to the coast-ranges and the veld, it will be long before those friends can repay what they themselves received. The guidance then given by Dr. Rogers is renewed and extended in the present admirable volume.

G. A. J. C.

OUR BOOK SHELF.

The Romance of Modern Chemistry. By Dr. J. C. Philip. Pp. 348. (London: Seeley and Co., Ltd., 1910.) Price 5*s*.

ACCORDING to its subtitle, this book is "a description in non-technical language of the diverse and wonderful ways in which chemical forces are at work, and of their manifold application in modern life." After some prefatory historical and theoretical matter, the reader is provided with a wealth of brightly-written and interesting information about fuel and its uses, explosives, low-temperature and high-temperature appliances, and spectroscopy. Modern phases of agricultural chemistry and of industries relating to sugar, starch, fats, and oils are discussed, and the concluding chapters give well-chosen illustrations of applied chemical science in relation to the adulteration of food, the utilisation of by-products, coal-tar products, large-scale electrolysis, solutions, crystals, and industrial catalysis. The last chapter illustrates vividly the part that "accident" has played in chemical discovery.

The most formidable difficulty in writing a book of this kind is to get the reader sufficiently acquainted with the elements of chemical fact and reasoning to enable him to understand the applications. Dr. Philip has adopted a light treatment and allowed himself a free use of imagery of an anthropomorphic kind, which will probably make an impression. To a reader who knows just a little chemistry the interest from the beginning of chapter vi. to the end of the book (chapter xxx.) will be kept fully alive, and as the body of information contained in these chapters is just that which is apt to be omitted from school or evening-class courses of formal chemistry, the book has a very distinct place of usefulness. It is written with an unimpeachable knowledge of scientific chemistry, a very unacademic appreciation and knowledge of practical problems, and a certain amount of human nature, which make the best possible equipment for the author of a book intended to popularise science. The chapter on solutions is particularly worthy of mention as an example of admirable exposition. There are twenty-nine excellent illustrations, which have been selected with care and at considerable trouble, but a long accumulating detestation of the very names stalactite and stalagmite would have reconciled the present writer to a suppression of the three plates dealing with these bedridden natural and etymological phenomena.

A. S.

Hayward's Botanist's Pocket-book. 13th edition, revised and enlarged. By G. C. Druce. Pp. xliv+280. (London: George Bell and Sons, 1909.) Price 4*s*. 6*d*. net.

THE "Botanist's Pocket-book" is well known as a handy companion of a convenient size for the pocket, and containing sufficient data to determine ordinary plants in the field. The original work, published in 1872, was enlarged in 1886 by the addition of an appendix, but, as many changes have recently been rendered necessary, the publishers have wisely authorised Mr. G. C. Druce to make a thorough revision. The general plan remains the same, but there is evidence of Mr. Druce's emendations from the first page to the last. Notably, the synopsis of the natural orders has been corrected, the arrangement of the genera has been altered, and both genera and species have been carefully revised to incorporate the conclusions of present-day authorities and present the nomenclature in accordance with the recommendations of the Vienna Congress.

The revision gives all species and varieties, even certain hybrids, except for the genera Hieracium, Euphrasia, and Rubus. Although the identification of many critical species and varieties will not be decided in the field or even on the scanty data supplied, botanists will not cavil at the decision to include them, especially as it has not necessitated an increase in the size of the volume. It is not apparent why the family names Lamiaceæ and Graminaceæ have been coined, while the substitution of Pinaceæ for Coniferæ to include Taxus cannot be accepted; further, it would have been less perplexing to many botanists to find the nomenclature if not the sequence of the last edition of Babington's "Manual." Doubtless the last point has received the consideration of the reviser, who has rendered another service to botany by placing on record his conceptions based on many years' constant study of British plants.

Yorkshire Type Ammonites. Edited by Mr. S. S. Buckman. Part I. Pp. i–xii, *i–ii*, plates 12, and descriptions Nos. 1–8. (London: W. Wesley and Son, 1909.) Price 3*s*. 3*d*. net.

IT is intended that this work shall appear in about sixteen parts. The object of the publication is to give an adequate pictorial and critical revision of the type-specimens of Jurassic ammonites from Yorkshire which were unsatisfactorily described or figured by the early authorities Young and Bird, John Phillips and Martin Simpson. The treatment is similar to that in the well-known "Palæontologia Universalis," and the excellent illustrations in collotype process are from photographs of the actual specimens, mainly by Mr. J. W. Tutcher. In addition to a reprint of the original diagnoses, supplemented by useful critical remarks, the editor has supplied a clearly arranged and concise account of the comprehensive system of terminology which has been adopted by those who have made the most advanced studies of ammonite-development. He has also added some original and suggestive remarks on the cyclical development of the shell-form. In another section of the work there are useful notes on generic names. Twelve plates are issued in the present part, with text relating to eight species, and the introductory matter is uncompleted. This work will prove indispensable, not only to those who take a serious interest in Yorkshire geology, but to all students of Jurassic ammonites.

Klimatographie von Osterreich. Part IV. *Tirol und Vorarlberg.* By Dr. H. v. Ficker. Pp. vi+162. (Vienna: Gerold und Komp, 1909.)

THIS volume forms part iv. of the valuable handbook on the climatology of Austria which is being issued by the Zentralanstalt für Meteorologie und Geodynamik of Vienna. It deals with the Tyrol and Vorarlberg, and has been prepared by Dr. H. v. Ficker with the cooperation, in the botanical and zoological part, of Prof. von Dalla Torre. The region under discussion is one of special interest by reason of the great contrasts which it presents. The North Tyrol is formed by the valley of the Inn and its tributaries. Here we have a long valley running east and west, and protected both to north and to south by high mountains. Föhn winds are frequent, and have a decided effect in raising the mean temperature. As a result many flora and fauna which are characteristic of more southern latitudes manage to persist. In the South Tyrol the main valleys, Etsch and Eisach, run from north to south. To the north they are protected by the central Alpine range, but to the south they are freely open to the plain of the Po. The Pustertal, running west to east, forms a region by itself. It is freely exposed to winds from the east, which have a decided influence in lowering the winter temperature. Finally, in Vorarlberg we have again a different arrangement. The valleys slope down to the north-west towards Lake Constance. This fact has an important influence on the climate, as the prevailing wind over this part of Europe is from north-west. The climatological data are discussed on the lines suggested by Hann in his "Lehrbuch der Klimatologie," which have been followed also in the previous volumes of the series. The peculiarities of each region are clearly set out and contrasted with one another.

The Scholar's Book of Travel. Part i., The British Isles and Readings in Physical Geography. Pp. viii+197. Part ii., Europe. Pp. viii+198. Part iii., Other Lands. Pp. viii+200. Part iv., The British Empire. Pp. viii+200. (London: George Philip and Son, Ltd., n.d.) Price 1s. 3*d*. each.

Cambridge County Geographies. Cambridgeshire. By Prof. T. McKenny Hughes, F.R.S., and Mary C. Hughes. Pp. xiii+271. (Cambridge: The University Press, 1909.) Price 1s. 6*d*.

THE teaching of geography in this country is undergoing a complete change. Efforts are being made in every direction to create interest in the human aspects of geography and also to render the study of the subject a training in the methods of science. The pupil is no longer merely set to learn by heart lists of geographical data, but he is encouraged by the study of maps, by simple experiments, and by reference to original sources, to discover and to arrange facts for himself, and by his own efforts to arrive at simple, broad geographical principles.

"The Scholar's Book of Travel" is designed to provide the young pupil with literary extracts from books of travel, and to give him the opportunity of learning from first hand accounts about this and other countries. The four little volumes should serve a distinctly useful purpose, especially as they will probably send the learner to the excellent books from which the extracts are taken. The majority of the excerpts are from the older writers—Livingstone, Speke, Mungo Park, Defoe, Kingsley, Darwin, to name a few—but the beauty and interest of the passages will doubtless make the reader desire to read the works of modern travellers.

The volume dealing with Cambridgeshire follows the general lines of the series to which it belongs, and these have been described on previous occasions. The authors provide an excellent account of an interesting county, and readers will find that though called geography the book gives particulars of the geology, history, antiquities, architecture, and the roll of honour of the district.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Fertilising Influence of Sunlight.

THE past history of agricultural science furnishes several examples of belated explanations of the utility of practices the value of which has long become a tradition among practical men. The explanation of the value of leguminous crops in agriculture is a good example. While the recognition of the *rôle* of these crops in increasing the nitrogen supply in the soil has done much to improve agriculture in new countries, it has only served to provide a scientific approval of the cultural practices of ancient civilisations, such as that of India, where from time immemorial it has been the custom to grow leguminous crops in the rotation and also as one of the constituents of the mixed crops cultivated in many parts of the country.

Agricultural science has recently provided another explanation of an ancient Indian practice. In the *Journal of Agricultural Science* of October last, Drs. Russell and Hutchinson have found that partial sterilisation of the soil by heating or by poisons leads to an increase in the supply of nitrogenous compounds and to increased fertility. These investigators state that partial sterilisation of the soil kills off the phagocytes which live on bacteria, and also large organisms inimical in other ways to bacteria. At the same time the soil bacteria are killed off, but the spores remain which germinate and rapidly multiply when the soil is moistened. The new bacterial cultures increase at an enormous rate, and the resulting nitrogenous plant food becomes so great that plant growth is greatly stimulated. The authors then go on to state (p. 120):—"There is reason to suppose therefore that the large destructive and competing organisms will be found of common occurrence in ordinary soils, checking the beneficial bacteria and limiting fertility. An important practical problem arises: is it possible to suppress them in ordinary field soils by any economical and practical process?"

The practice among many of the best cultivators in the Indo-Gangetic plain furnishes a most emphatic affirmative to the above question. It has been the practice of the ryots for centuries past to expose the alluvial soils of the plains of India to the intense heat and light of the Indian hot weather in April and May. The beneficial result on the succeeding crop is extraordinary, and has all the effect of a nitrogenous manuring. It is much more than probable that the result of this weathering is a partial sterilisation of the soil, and that Russell and Hutchinson's explanation is the correct one. Except in market-garden crops near the cities and in crops like sugar-cane and tobacco, manures are but little used in India. The growth of leguminous crops and the weathering of the soil during the hot season appear to be sufficient to keep up the fertility. More nitrogenous manure would no doubt be an advantage, but a great deal could be done by the cultivators themselves in weathering the soil during the hot weather in a more efficient manner than at present.

The extended use of cheap light iron soil-inverting ploughs during the hot, dry weather after the *rabi* harvest would do much to bring about a better exposure of the soil to the sun, and a more complete sterilisation. The wooden ploughs now in use are not adapted to open up the heavier lands unless they are moistened by rain, and in consequence a large area of the arable land is not ploughed at all until the monsoon. We consider one of the greatest improvements possible in Indian agriculture would be to impress on the ryot the value of weathering all arable lands in April and May to a much greater extent than is done at present. When iron has taken the place of wood in the ploughs of the Indo-Gangetic plain, it will be possible for the cultivator to take the fullest advantage of, and greatly extend, their present most admirable practice. In collaboration with Mr. H. M. Leake, economic botanist to the Government of the United Provinces, we have in progress a series of experiments in which the practical effect of weathering during the hot months on both the yield and quality of wheat is being ascertained.

A. Howard.
G. L. C. Howard.

Pusa, November 18, 1909.

A Note on the Gilded Metal-work of Chiriqui, Central America.

Among the minor ethnological problems which America offers in such variety, not the least interesting is that of the origin, significance, and method of production of the specimens of gold-work found so abundantly in certain parts of Central America and in the north-western regions of the southern continent.

The earliest European voyagers who reached the shores of the New World directed attention in their narratives to the gold ornaments and little images of "frogs, birds and men" found in the hands of the natives, and, as Humboldt urged long ago, arguing erroneously from the accumulated riches of generations of savages, they attributed great mineral wealth to the newly discovered lands, giving them such sounding names as Costa Rica and Castillo del Oro.

Articles of gold alloy are widely distributed throughout South America, and vary as greatly in artistic and technical execution as in the purity or baseness of the metal from which they have been fashioned. This metal-work has long been known to students, as well as to treasure-hunters, and is of so extraordinary a character that it at once attracts attention. Running riot, heedless of the proprieties, its motives include every variety of zoomorphic design—human, bestial, bird, fish, or reptile; all types of life are represented, together with monstrosities and ambiguous shapes bordering frankly on the diabolical.

A certain amount of South American metal-work finds its way every year to England through dealers who purchase it from natives and speculators who make it their business to explore the ancient burial places. Practically the whole of this is melted down on account of its intrinsic value, but it is comparatively seldom that objects of artistic or archæological interest are lost to science in this manner, by far the greater portion of the work being of the crudest description.

The present letter deals more particularly with the gilded metal-work of Chiriqui, on the southern boundary of Costa Rica, which presents features of peculiar interest. It has been studied carefully by Holmes, whose work on the subject, embodying references to the earlier literature dealing with it, is to be found in the report of the Bureau of Ethnology for the years 1884–5.

The immediate interest of the subject turns upon the occurrence of objects fashioned from copper-gold alloys of very variable composition, the latter metal being present in some instances in a proportion insufficient sensibly to alter the colour of the copper, whilst, nevertheless, the surface of the objects presents a burnished coating of fine and splendent gold. In many examples the film of precious metal is so slight that it has all the appearance of electroplated work, and many conjectures have been hazarded to explain the method by means of which the native artist produced the effect.

Holmes, in the treatise already cited, quotes, on the authority of Bollaert, a reference to the works of Acosta to the effect that the Indians of New Grenada gilded copper by rubbing it with the juices of certain herbs and afterwards subjected it to the action of fire, when it took the gold colour, but states that he had not been able to find the passage in question. The present writer has also searched the pages of Acosta in vain, but it is probable that Bollaert quoted from memory the following passage in the "History of the Indies" of Gonzalo Fernandez de Oviedo (Edit. Amador de los Rios, vol. iv., p. 189), where that writer says, freely to translate the paragraph:—"I would wish to say how the Indians [of the Antilles, and especially those of Hayti] know well how to gild the little things they make of copper, very yellow like gold. They have in this such skill and excellency, and give such a deep lustre to that which they gild that it seems to be good gold of 23 carats or more by its colour when it leaves their hands. This they do with certain herbs, and is such a great secret that whoever of the goldsmiths of Europe or of any other part shall find it out, he will be a very rich man, and that in a very short time if he uses this manner of gilding." The old historian of the Indies made efforts to learn from the Indians this secret process, but they excused themselves on the plea that the herbs made use of were unknown to them, and that the small quantity they possessed of them came from very distant countries.

"It is not impossible," says Holmes, "that an acid may have been applied which tended to destroy the copper of the alloy, leaving a deposit of gold upon the surface, which could afterwards be burnished down. . . . It is possible that the film of gold may in some cases be the result of simple decay on the part of the copper in the alloy . . . but the surface in such a case would not be burnished, whereas the surfaces of the specimens are all neatly polished."

The operation above mentioned, whereby the apparent quality of articles of gold alloy is improved by the artificial enrichment of the superficial layer, is one frequently practised among goldsmiths, who term it "colouring." A hot process, involving the use of fused salts, is generally made use of (*vide* T. K. Rose, "Metallurgy of Gold," edit. 1906, p. 19; W. T. Brantt, "Metallic Alloys," London, 1896; and Gee, "Goldsmith's Handbook," 1881).

Considering it probable that a germ of truth lay in the information given by the Indians to Oviedo, the writer made several experiments of a simple character to endeavour to clear up this point. It was found that by acting upon a base alloy with dilute nitric acid, a black lustrous film of gold could be readily obtained by removing in solution a portion of the copper. By heating the object thus treated out of contact with air, the black film of gold is annealed, changing to the yellow modification, and is left in a condition to be readily burnished with any suitable implement, for example, a water-worn pebble of quartz.

The mineral acids being, presumably, unknown to the craftsmen of pre-Colombian America, advantage was taken of the solubility of copper in organic acids in the presence of air, and after a few successful preliminary experiments with the pure chemical products, various acid plant juices, the "herbs" of Oviedo's Indians, were tried, and fully answered expectation. There can be little doubt that the Indians had no need to ransack "distant countries" for the wherewithal to gild their ornaments; but every craft has its mysteries.

It was found that among the various organic substances tried in the course of the experiments few effected the required reaction so readily as urine, which, with free access of air, rapidly covers the surface of the alloy with a coating of hydrated copper salt readily soluble in acid plant juice. When performed with the aid of these natural reagents, the operation is a very tedious one, the gold film, in the case of base alloys, taking months to acquire sufficient substance to admit of being burnished; but time signifies little to the savage.

In conclusion, although not desirous of affirming that the procedure described was that invariably followed by the Indians in the production of gilded work, the writer is decidedly of the opinion that their operations broadly followed the lines indicated in the present letter.

Oswald H. Evans.

"Arauco," South Harrow, February 1.

Suggested Common Day of Meeting for London Societies.

Will you permit me to make a suggestion regarding the days of meeting of learned societies in London? At present these days seem to be selected in a very arbitrary manner, with the result that the provincial members of the societies are often called to London on several days during the same week. For instance, last autumn I ought to have attended no fewer than four such meetings during the same week, namely, on Monday, Tuesday, Thursday, and Friday. It is, of course, impossible for the majority of provincial members of London societies to give up so many days—we are generally compelled in such circumstances to abandon all the meetings. By some curious law of chance, moreover, it generally happens that two meetings occur with just an interval of one day between them, which makes it still more difficult to attend either.

Would it not be possible to fix one day, namely, Friday afternoon and evening, as a general day of meeting for the societies? This would, I feel sure, allow many provincial members to come down to London for the occasion, partly because they could merge the Friday with their "week-end," and partly because they might have the chance of attending several meetings the same afternoon and evening. I doubt whether such an arrangement would inconvenience many of the London members; but, even if it does, the London members might perhaps be willing to give way, because to them, in any case, attendance is much more easy than it is to men who live perhaps hundreds of miles away. I have discussed the matter with several friends in Liverpool, all of whom seem to be favourably impressed with the idea. RONALD ROSS.

Johnston Tropical Laboratory, University of Liverpool, February 5.

The Meaning of "Ionisation."

IN his interesting notice concerning the work of Arrhenius, published in NATURE of February 3, Prof. Walker, in a somewhat ambiguous manner, refers to "the notion and practical definition of degree of ionisation" as the great positive contribution of the distinguished physicist. "Whatever be our views of the origin and nature of ions, we must" . . . —he says—"have recourse to the notion of degree of ionisation." It is a little difficult to see how we are to have recourse to a notion if we are not clear what view that notion is based upon and includes. To appreciate Prof. Walker's position, it is essential that we should know precisely what meaning he attaches to the words I have quoted—what conception underlies them. I would beg Prof. Walker to tell us, in clear, unmistakable terms, what exactly he would have us understand by the word *ionisation*.

When the Royal Society has completed its Catalogue of Scientific Papers of the last century, it will doubtless be compelled to prepare a dictionary in explanation of the terminological inexactitudes to be found in its Proceedings and other journals; of these, *ionisation* will be one of the most difficult to interpret. Prof. Walker will render real service if he will tell us in what sense or senses he uses the word throughout his notice; does he or does he not use it as connoting explicitly the separation of a substance in solution into several portions, each capable of acting as a distinct kinetic unit? This, I believe, was the doctrine enunciated by Arrhenius in 1887, and which, if I mistake not, he still professes. Does Prof. Walker advocate such doctrine?

HENRY E. ARMSTRONG.

PROF. ARMSTRONG and I look at *ionisation* from different points of view. He is chiefly interested in an interpretation of the process and phenomena of ionisation in terms of the kinetic molecular theory. I am chiefly concerned to have a theory, whatever be its exact mechanical interpretation, which is capable of being mathematically formulated and of acting as a guide in quantitative investigation. My position, in short, is that of the astronomer who is content to have Newton's law for practical purposes, and only takes a speculative interest in theories of the nature of gravitation.

Possibly the best analogue in physics to Arrhenius's theory of electrolytic dissociation is van der Waals's theory of the continuity of the gaseous and liquid states. Van der Waals's theory can be put in the form of a comparatively simple equation which is very successful in representing the facts in broad general outline, though in many cases it proves to be imperfect in detail. Although the kinetic molecular assumptions on which van der Waals based his theory may be questioned, his equation will remain an important aid to investigation in its special domain until it is superseded by another of comparable simplicity and of greater comprehensiveness.

JAMES WALKER.

The Invention of the Slide Rule.

IN NATURE of January 13 (p. 307) Dr. Alexander Russell, in writing of the invention of the slide rule, says:—"Supporting the latter view is the fact that he (Oughtred) published (1633) his 'Mathematicall Recreations' under the pseudonym of Henry Van Etten." This evidently implies that Oughtred was the author of the said "Mathematicall Recreations," whereas the very title of the work shows that it was a translation, and not an original contribution. It reads:—"Mathematicall Recreations; or a collection of sundrie problemes and experiments in arithmeticke, cosmographie, astronomie, architecture, chimistrie, &c., extracted out of the ancient and moderne philosophers, *now delivered into English tongue* with the examinations, corrections and augmentations by W. Oughtred."

The italics are ours. The translation was made from the French of Henry Van Etten's "Recreation Mathematique, composee de plusieurs problemes, plaisants et facetieux, en fait d'Arithmétique, Geometrie, Mecanique, Optiq.; et autres parties de ces belles Sciences." The accents are missing in the title-page. The work was published in Paris in 1624. The name of Henry Van Etten is indeed a "pseudonym," but it is that of Jean Leurechon (1591–1690), a French Jesuit of uncommon mathematical versatility, and not that of William Oughtred (1574–1660), an English divine of no less uncommon mathematical ability.

BROTHER POTAMIAN.

Manhattan College, New York City, January 27.

Transit of Halley's Comet.

MAY I point out that at the time of the transit of Halley's comet the sun will be above the horizon at the North Cape? The Cape is distant 18° 49′ 20″ from the pole, and the declination of the sun at midnight of May 18 will be 19° 31′ 42″; adding 27′ 22″ for refraction, the sun's altitude at midnight would be 1° 9′ 44″, and the altitude would increase before the first contact, which will take place at 16h. 6m. local time. The Cape rises to a height of 968 feet, and there should be a very fair sporting chance of seeing something of whatever there may be to see during the sixty minutes' duration of the transit.

C. S. TAYLOR.

Banwell Vicarage, Somerset, February 11.

Dangerous Lecture Experiments.

ALTHOUGH it is no part of my duty to teach chemistry, I have on several occasions had to perform an experiment which Mr. Marle quotes (p. 428) as being dangerous, viz. the collection of hydrogen from the action of sodium on water. I can fully endorse his warning. Twice a violent explosion took place; but I found that if the piece of sodium is carefully cleaned so that all its surfaces are bright, and cold water used, the experiment can be carried out in safety. I do not know if these important details have found their way into the practical manuals in use in chemical laboratories. If not, I trust that this experiment is not one that beginners are directed to make.

M. D. HILL.

Eton College, Windsor, February 11.

Aged Tadpoles.

LAST year I reared about five thousand tadpoles, and, dividing them into twenty portions, brought most of them to the frog stage. As they matured, and the numbers became smaller, the survivors were gradually brought together again into a few vessels, finally into one. Of those which were in the tadpole stage in November, none changed to frogs. They died one by one until only two are left. These are quite healthy—active feeders with long tails and hind legs, but no appearance of fore legs. Perhaps some of your readers will be able to say whether it is usual to have tadpoles a year old, and whether one may expect any change to take place now—whether, perhaps, like Axolotl, they may not exhibit the power of reproducing their own kind if they remain alive.

JOHN DON.

Carrick Academy, Maybole, N.B.

SOUTH SEA SAVAGES.[1]

MR. H. W. WALKER, in an account of his wanderings among the savages of Fiji, the Philippines, Papua, and Borneo, has not set himself the task of dealing scientifically with ethnographical details. He has aimed rather at giving a general impression of native life and environment in some of the more out-of-the-way corners of the island world. In this aim he has admirably succeeded, and his book affords a vivid picture of the people and regions which he has endeavoured to describe.

The first chapters recount a visit to Ratu Lala, chief of the Fijian island of Taviuni. Here, under the thin veneer of civilisation produced by two years' schooling at Sydney, was found a man at heart a savage, who could boast of how he treated his jester as a fish and played him with hook and line, or pegged a woman on an ant-hill, smearing her with honey to make the ants bite.

In this and the following chapter on the ex-cannibals of Na Viti Levu, "who would still like to eat man if they got the chance," Mr. Walker describes Fijian dwellings, customs, and war ceremonies.

In the Philippines the author visited Pampanga, in North Luzon. In the mountains near Florida Blanca he stayed with some friendly Negritos, of whose appearance, dress, ornaments, and weapons he gives an interesting account. While staying here Mr. Walker heard of a strange people called Buquils, who lived further in the mountains, and were reported to be Negritos with long smooth hair. The women were said to have beards. Mr. Walker made a difficult mountain journey with his Negrito friends to try to find these people. When almost in touch with the Buquils, however, the Negritos refused to proceed further until they had sufficient fighters to avenge the killing of their fellow-tribesmen who had ventured into the Buquil country. Mr. Walker had to catch his steamer, and could not wait for them.

Mr. Walker next describes his adventures during a Government punitive expedition against the Dobodura tribe in North-east British Papua. Although on the warpath, the author was not unmindful of natural scenes, and gives some interesting notes on plants, birds, and forest scenery. Mankind was less pleasant, and as the party passed along they saw "in each village plenty of human skulls and long sticks with human jawbones hanging upon them." A brisk description is given of the skirmishes and night attack. Once the author was separated from his party, and had some lively anticipations of taking a too prominent part in a cannibal feast. For the Dobodura were cannibals of a very pronounced type, and the author's headings and items in these chapters are suggestive of a ghastly nightmare. "Pigs shot to prevent them from being cooked alive.—Revolting relics of cannibal feast.—Doboduras eat their enemies alive.—Method of extracting the brains.—Man better than pig.—Carriers ask leave to eat one of the slain.—Horrible barbarities of the Doboduras.—Unpleasant anticipations.—Two miners roasted alive." Incidentally, in these chapters Mr. Walker bears witness to the smartness, pluck, and good humour of the native Papuan police. In the same region of Papua, the author, with Messrs. Monckton and Acland, discovered a peculiar tribe of flat-footed lake-dwellers, whom report had credited with webbed feet like a duck. There was some truth in the report, and Mr. Walker gives a description of the people and an account of their customs quoted from Sir F. Winter.

A Negrito Family. From "Wanderings among South Sea Savages," by H. Wilfrid Walker.

The next chapters relate to the head-hunting Sea

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[1] "Wanderings among South Sea Savages and in Borneo and the Philippines." By H. Wilfrid Walker. Pp. xvi + 254. (London: Witherby and Co., 1909.) Price 7s. 6d. net.

Dayaks in Sarawak. The author gives interesting notes on Dayaks and heads, and a gruesome story of a head-hunting exploit. Later he lived with Dayaks on the Sarekei River. The chapter in which he describes his life among them is one of the best in his book.

The final chapter is an account of a visit to the famous birds'-nest caves of Gomanton, in British North Borneo. Of these caves and their inhabitants —birds and bats—an interesting account is given. Incidentally also a good word-picture is given of Borneo river and jungle life.

Mr. Walker has told his story in a very natural and entertaining way. There are no dull pages. Some of his cannibal and head-hunting tales may be *horrendum dictu*, but even these are to be matched by facts culled from many an official report on these wild people of the South Seas.

The book is well illustrated by forty-eight illustrations from photographs, and has a useful index.

S. H. R.

THE FRENCH ANTARCTIC EXPEDITION.

THE French expedition under Dr. Jean Charcot, on board the *Pourquoi Pas?* returned to Punta Arenas at the end of last week. The early return of the expedition, some weeks before it was expected, is due to a series of misfortunes which limited the range of the expedition's operations.

It will be remembered that this is the second of Dr. Charcot's Antarctic voyages. In 1903–5, on board the *Français,* he carried out an expedition along the west coast of Graham Land, south of Cape Horn, wintering on Wandel Island, in about 65° S. lat., and continuing the voyage to a point off Alexander I. Land in about 68° S. lat. Apart from the additions made to cartographical knowledge of some of the islands off Graham Land, the expedition was notable for the scientific observations and collections secured in the departments of hydrography, terrestrial magnetism, biology, botany, and geology.

Dr. Charcot's latest expedition was designed to extend the work done in 1903–5. The programme contemplated another cruise among the islands off the west coast of Graham Land, whence it was hoped to continue the voyage westwards in the direction of King Edward VII. Land; it was also proposed to make excursions southwards to investigate the character of the supposed Antarctic continent, and for this purpose the *Pourquoi Pas?* carried a number of specially designed motor sledges. The expedition was liberally subsidised (24,000*l.*) by the French Government, and the ship, a barquentine with an auxiliary engine of 550 h.p., was specially built for the voyage. The French Naval Department, the Paris Museum, and the Prince of Monaco contributed to the scientific equipment, and the scientific staff included, besides Dr. Charcot, who belongs to the medical profession and is an experienced bacteriologist, specialists in hydrography, oceanography and meteorology, tidal and chemical observations, geology and glaciology, natural history, and terrestrial magnetism.

The expedition sailed from Havre in August, 1908, and from Punta Arenas in the following December. Supplies of coal were taken on board at Deception Island (lat. 63° S.), in the South Shetlands, which has become an important rendezvous for whalers. On resuming the voyage the *Pourquoi Pas?* ran aground, and after being re-floated lost her rudder in collision with icebergs. The voyage, however, was continued to Adelaide Island, south of the 67th parallel, and the adjacent coasts were explored for a distance of 120 miles to Alexander I. Land. Being unable to find a safe anchorage, the expedition then returned north and spent the Antarctic winter of last year off Petermann Island, south of the 65th parallel. Though attacked by scurvy and other diseases, the explorers carried out several excursions, and made a careful study of the glaciology of the region. On the return of summer they continued their explorations among the South Shetlands, again visiting Deception Island, and also Bridgman Island (62° S.). The course of the *Pourquoi Pas?* was then directed south and west, and the expedition succeeded in reaching Peter I. Island (lat. 69° S., long. 90° W.). Ultimately the voyage was extended, between the 69th and 71st parallels, to long. 126° W. King Edward VII. Land extends between the 150th and 160th meridians of west longitude.

Graham Land projects northwards from the Antarctic Circle towards Cape Horn as a great tongue of land with numerous adjacent islands. It has been visited by several expeditions, but its connection with the Antarctic continent is still a matter of speculation. Westwards, in the region south of the Pacific Ocean, Cook and Bellingshausen sighted stray patches of land or appearances of land, presumably part of the Antarctic continent, but the continuous coast has never been definitely traced. Geographically, the value of Dr. Charcot's expedition consists in the work he has been able to accomplish in linking up and defining more clearly the character of these stray patches of coast. Exactly what have been the results of the expedition in this connection can only be determined when his charts become available. As on the occasion of his former expedition, the most valuable feature of the results will probably be the scientific data collected respecting the magnetic, meteorological, hydrographical, and geological conditions in the regions south of Cape Horn. Dr Charcot was unable to make use of his motor sledges for penetrating the Antarctic continent.

RADIUM IN DISEASE.

ATTENTION has again been directed to the possibilities of radium as a curative agent by Sir William Ramsay (at the Authors' Club on Monday), and by Sir Lauder Brunton (in the *Lancet*).

The supply of radium available for the treatment of disease is still so limited that the therapeutic usefulness of this agent has not yet been fully determined. No sooner were indications noted of a prospect of relieving cancer by the use of radium than all the radium obtainable was devoted to this purpose; consequently, its action in less serious ailments is still almost unknown.

In the treatment of cancer, radium has usually been employed in the form of crystals of the bromide. These crystals are contained either in a sealed glass tube or in a button with a covering of thin glass, aluminium or mica. Recently the crystals have been spread in a thin layer upon a flat surface and covered with a layer of varnish. Such buttons and spread preparations are suitable for application to the surface of the body. The glass tubes may be inserted into the interior of tumours, or into orifices of the body; thus, they may be placed in the mouth or nose, in the œsophagus (within a rubber tube), in the rectum, or in the cervix uteri.

Of the three types of radiation given off by radium (the alpha, beta, and gamma radiations), the view commonly accepted is that the gamma rays have a selective action, destroying cancer cells while leaving the normal cells of the part intact, while the alpha and soft beta rays destroy all cells indiscriminately. Means must accordingly be used to prevent the alpha and soft beta rays from reaching the body. A filter consisting of one millimetre thickness of lead is suitable.

As it is risky to send a patient away with a valuable tube of radium crystals within his body, sealed glass tubes of radium emanation have recently been used (*Lancet*, December 11, 1909). They are enclosed in lead tubing one millimetre in thickness. These tubes of emanation do not differ from the crystals in the rays they emit or in their action; there is, however, one important difference; the radio-active strength of the emanation tube decays according to an exponential law in such a way that the strength is reduced to one-half at the end of about four days. Such tubes, of about 10 milligramme strength, may be placed in contact with a cancerous growth (say in the rectum) and allowed to decay *in situ*. At the end of a fortnight they may be removed, as being then too weak to be of further use.

Other methods have been tried in a few cases; thus, dilute solutions of radium bromide have been given by mouth, and water in which radium emanation has been dissolved has been injected subcutaneously.

Coming now to the results obtained, the accounts are very conflicting. Undoubted relief has been obtained in a considerable proportion of the cases; cancerous tumours have diminished in size, and have disappeared altogether in some cases. But some of the earlier cases reported as cured have since been found to relapse; in some cases the growth has recurred in the original situation, while in others cancerous deposits have formed in internal organs. It seems fairly certain that in some cases cancerous growths may be cured in their early stage by radium, but it is not yet justifiable to attempt this unless the patient is so feeble (through heart disease or Bright's disease, for instance) that the removal of the growth by operation could not be undertaken.

When the surgeon has declared a case inoperable, radium (or Röntgen ray) treatment is used as a last resource, and the attempt is usually a desperate one. It is something, then, to be able to report the complete disappearance of malignant growths in some of these cases, even though the final result is not a cure. The local treatment of cancerous growths does nothing to prevent dissemination of the disease in the internal organs, and it is with the idea of achieving this result that attempts have been made to cause radium or its emanation to circulate through the body. In doing so it must be remembered that the alpha radiation is giving out its full energy in the body; and since this radiation possesses about a hundred times as much energy as the beta and gamma radiation together, it is clear that for practical purposes we may disregard the effect of the gamma radiation in this connection. Now, we started with the postulate that the alpha rays are indiscriminately destructive, so that if enough is allowed to circulate in the body to destroy cancer cells, the normal cells of the body will also be destroyed. It must be allowed, however, that the observations upon which this postulate are founded are by no means conclusive, and though there is no doubt that the alpha and soft beta rays destroy normal cells far more readily than is the case with the gamma rays, it may still be true that they too possess some degree of selective action, if the dosage be regulated with sufficient accuracy.

This branch of therapeutics is still in its infancy, and it would be a mistake either to raise delusive hopes because some cancerous growths have been made to disappear under its use or to declare it useless because disappointments are common. One disease, rodent ulcer, is cured by the use of radium in the great majority of cases, only a few rodent ulcers proving refractory to its use. There are, however, other methods of curing rodent ulcer. The further development of this branch of medical science will be watched with great interest.

A SIMPLE METHOD OF ELECTROPLATING.

At a meeting of the Royal Society of Arts on February 2, a paper by Mr. A. Rosenberg was read upon an improved method of electroplating. Mr. Rosenberg dispenses altogether with the plating bath and all external sources of electricity. The plating is carried out simply by rubbing on a powder moistened with water. The process is really a refinement of the old contact method. It will be remembered that in this process a piece of metal which it is desired to plate upon is immersed in an electrolyte, for example, one containing a silver solution. In contact with this metal a more electropositive one is placed, also dipping into the electrolyte. This metal, usually zinc, passes into solution, and an electric current thereby is generated. The silver is then plated-out upon the less electro-positive metal.

Mr. Rosenberg employs his electro-positive metal in the form of a fine powder, and generally uses magnesium. This is mixed with a metallic salt or with the powdered metal it is desired to plate-out, and ammonium sulphate or other ammonium salt. In order to plate a piece of metal the powder is moistened with water and rubbed over its surface by means of a piece of rag or a brush. By this means adherent and bright deposits are obtained in about one minute, the thickness of the deposit depending upon the time employed and the quantity of powder used.

The magnesium, being strongly electro-positive, reacts with the moist electrolyte, and goes into solution, causing the metal to be plated-out upon the metallic surface which is being rubbed. In other words, each particle of the powdered magnesium may be said to function as a minute anode. One of the difficulties in electroplating is to plate a substance upon itself. It is easy enough when plating has once commenced, say on a spoon, to give it almost any thickness of deposit; but if the spoon is once withdrawn from the bath and used, it cannot be plated further without first stripping off the old deposit. Mr. Rosenberg claims that with his process this difficulty does not occur.

Another great difficulty in electroplating is the cleansing of the article to be plated; the least trace of grease, even that produced by handling, for example, will prevent an even and adherent deposit. Consequently, articles have, as a rule, to be chemically and mechanically cleaned before being put into the plating bath. With the powder, "Galvanit," of Mr. Rosenberg this is not necessary, because the act of rubbing the powder carries out its own cleansing.

The author's object has been to produce a household method of plating. Thus, when the tinning of saucepans is worn out, the householder has only to polish the inside with the moist "tin Galvanit" to re-tin the saucepan. Spoons from which the silver-plating is partly worn can be re-plated. The "nickel Galvanit" can be used for bicycles and so on. Mr. Rosenberg demonstrated the process before the meeting by plating an iron tube with cadmium, a copper tube with nickel, a penny with silver, and a brass tube with tin.

"Galvanit" can also be used for nickel-facing electrotypes. The process is certainly ingenious, and will no doubt be found useful for small work, but it is hardly likely to enter into competition with ordinary electroplating for large work or for irregular articles. Nor is it likely to be employed in cases where heavy coatings of metal are required, because it would not be an easy matter to rub on sufficiently evenly to obtain uniform and thick deposits. F. M. P.

UNIVERSITY COLLEGE, LONDON.

APPEAL FOR NEW CHEMICAL LABORATORIES.

MANY old students of University College, London, and others familiar with the work done in the chemical department of the college, will be interested in the appeal which has just been made for funds for new chemical laboratories.

The letter which Lord Rosebery has written as Chancellor of the University, and the statement circulated by Sir Henry Roscoe, as chairman of the Equipment and Endowment Fund Chemistry Appeal Committee, serve to bring into high relief the urgent need at University College for improved and more extensive accommodation in its chemical department, both for teaching and research purposes.

While, thanks largely to the generosity of Mr. Carnegie, the University of Manchester has recently become possessed of adequate and modern laboratories, and fine buildings possessing admirable accommodation for chemical science have been erected at South Kensington—to give two examples only—the University College laboratories date from 1871. Yet, despite material disadvantages, splendid work for chemistry has been accomplished in Gower Street under Graham, Williamson, Sir William Ramsay, and others.

In America to mention the need and to state the sum required would ensure its being immediately forthcoming, especially when it can in a sense be regarded as a means of celebrating the completion by Sir William Ramsay of twenty-one years of work at University College. In Germany, again, the State would see to it that so distinguished a chemist was not hampered by want of material or accommodation.

We are hopeful that a ready response to the appeal will be promptly forthcoming, and that very soon the necessary buildings will be in course of erection. The appeal, and Lord Rosebery's letter referring to it, are subjoined.

An Appeal for 70,000l. for the purchase of a Site and the erection of new Chemical Laboratories thereon at University of London, University College.

The chemical laboratories at University College, London, were for the most part built under the direction of the late Prof. Alexander Williamson in the year 1871. From time to time they have been re-fitted and supplemented to meet the demands of the subject and the increasing number of students in the department. It has been impossible in the present buildings of the college to provide the requisite additional accommodation in rooms immediately adjoining the main laboratories. Consequently, at the present time the department is scattered and inconvenient, and neither in planning nor equipment is it adequate for modern chemistry work. The average number of students in the chemical department for the last four sessions has been 261, of whom, on the average, 160 have been students in the junior classes, 68 students in the advanced laboratories, and 33 research students.

During the last four sessions, the college has been compelled to refuse students for want of room, even after making such arrangements as have been possible for the laboratory work of some students elsewhere. The number of those who desire to do research work under Sir William Ramsay and Prof. Collie has also increased to such an extent that additional accommodation is now a matter of urgent necessity.

The lack of adequate accommodation for the department of chemistry at the college has been carefully considered by the University and college authorities, and the conclusion has been arrived at that nothing short of entirely new buildings can meet the necessities of the case, a conclusion confirmed by the Treasury Commissioners at their last inspection of the college, and also by the University inspectors.

The provision of new buildings for the department of chemistry will greatly benefit other branches of university study now hampered for want of room. The space in the present buildings vacated by the department of chemistry will go some way towards supplying the deficiency of space for other subjects.

It was originally proposed to provide the requisite accommodation for chemistry by erecting the north-west wing of the college on the Gower Street frontage, but a more convenient site has been found fronting Gower Place on the north side of the present buildings of the college. This site has a frontage of about 316 feet and an average depth of 66 feet, with a superficial area of about 20,800 feet, and is suitable in every way for the erection of chemical laboratories. The Senate has acquired an option lasting for a short period to buy this site at an agreed price.

The erection of the north-west wing of the college would necessarily be expensive, because it must be built in Portland stone and correspond in elevation with the remainder of the quadrangle of which it would form part, and for these reasons it would not be suitable for chemical laboratories. It is estimated that the cost could not be less than 70,000l.

For this sum (70,000l.) not only could the freehold of the proposed new site be acquired, but a suitable building for the department of chemistry could also, it is estimated, be erected upon it.

If sufficient money is not immediately forthcoming to complete the whole scheme, the earlier subscriptions will be applied in purchasing the site.

The services to chemical science which have been rendered by Sir William Ramsay, the university professor of general and inorganic chemistry, who has recently completed twenty-one years' work at the college, and the important discoveries that he has made, are generally well known. In addition to these, the number of researches published during the past twenty-two years by members of the staff and students of the chemical department amounts to 331; of these, 72 have been carried out by Sir William Ramsay and collaborators. It is interesting to observe that while the total number of researches published from the department from 1887–1902 was 115, the number issued since 1902, when the laboratories were enlarged, to the present year is already 216.

It is the wish of Sir William Ramsay's friends and of his old students to see his desire for adequate and well-equipped chemical laboratories realised as speedily as possible.

This appeal for 70,000l. for new chemical laboratories is therefore made to all who are interested in the advance of chemical science, and also to all who desire to see university teaching in London developed in accordance with its needs.

Donations or subscriptions, which may be paid in instalments, should be sent to the chairman or the treasurer of the new chemical laboratories fund, and addressed to University College, London.

HENRY E. ROSCOE (*Chairman*).

Letter from the Chancellor of the University.

Dalmeny House,
Edinburgh.
January 23, 1910.

I earnestly hope that the friends of the University of London and the admirers of Sir William Ramsay will cooperate to ensure the success of this appeal for 70,000l. for an academical necessity.

Should the admirers of Sir William Ramsay alone take the matter up in proportion to their zeal and his merits, there can be no doubt of the necessary fund being raised.

But indeed those who are interested in the well-being of our university, either from their association with it or on high public grounds, will, I am sure, spare no effort to ensure the prompt erection of the chemical laboratories so urgently needed for its work.

ROSEBERY (*Chancellor*).

ASPECTS OF ASTRONOMY.

AT the anniversary meeting of the Royal Astronomical Society on February 11, the gold medal of the society was presented to Prof. Friedrich Küstner, director of the Royal Observatory, Bonn, for his catalogue of stars, his pioneer determination of the aberration constant from motions in the line of sight, and his detection of the variation of latitude. In his address as president of the society, Sir David Gill described the valuable work done by Prof. Küstner in each of these directions. He prefaced his remarks by saying:—

> Astronomy in one sense or another appeals to minds of widely different orders. To the mathematician it offers problems of infinite interest; but, as we all know, there have been most distinguished workers in the field of astrodynamics to whom the spectacular glories of the heavens do not appeal—to whom the first sight of an object like Saturn or a great star cluster as viewed through a good telescope brings no thrill, no insatiable desire to see more or to acquire or devise means for so doing. Such men are too apt to regard the art of observing as a mere mechanical operation that is unworthy of their practical study; but they are thus frequently placed in the position of having to employ observations about which they have not the capacity to distinguish between the good and the bad.
>
> There is a larger number of persons who are not wanting in the emotional response to their first telescopic sight of celestial objects; some of these acquire, or are driven to construct, instruments to indulge their awakened curiosity, and not a few of them afterwards do useful work as astronomical observers.
>
> The attributes of the great majority of astronomers lie between these two extremes; but the number of men who possess the true fire and natural capacity for the most refined original research in the field of astrometry is limited. Such men must have an inborn natural mathematical, mechanical, and manipulative aptitude; the critical faculty to discern the possible sources of error to which any class of observations may be liable, with the inventive capacity to devise means for their elimination; and that persistent patience and divine discontent with their own best efforts which alone can lead to the highest and most refined class of work.

NOTES.

THE following telegram from the Paris correspondent of the *Times* appeared in the issue of that journal for February 16:—"Paris, February 15.—According to a communication made yesterday to the Academy of Sciences by M. Lippmann, Mme. Pierre Curie, the widow of M. Pierre Curie, the discoverer of polonium and radium, has at last succeeded in isolating one-tenth of a milligram of polonium. In order to obtain this result, Mme. Curie, working in cooperation with M. Debierne, has had to treat several tons of pitchblende with hot hydrochloric acid. The radio-active properties of polonium turn out to be far greater than those of radium. It decomposes chemically organic bodies with extraordinary rapidity. When it is placed in a vase made of quartz, which is one of the most refractory of substances, it cracks the vessel in a very short time. But a no less distinctive quality of polonium is the comparatively rapid rate at which it disappears. Whereas it takes one thousand years for radium to disappear completely, a particle of polonium loses 50 per cent. of its weight in 140 days. The products of its disintegration are helium and another body, the nature of which has not yet been ascertained, but Mme. Curie and M. Debierne are inclined to believe it to be lead. Its identity, however, will shortly be established, and at the same time science will have had the experimental proof of the transformation of a body which had been believed to be elementary."

WE learn from the Paris correspondent of the *Chemist and Druggist* that the administrative council of the Pasteur Institute has decided to establish a laboratory for the study of radio-activity and its therapeutic applications. This laboratory will adjoin the Oceanographic Institute there. The Pasteur Institute will devote to this object 400,000 francs of the Osiris Legacy. The University of Paris will give the land and find the rest of the money. Mme. Curie will be directress of the physical side of the laboratory, and the other section (researches as to practical applications of radio-therapy) will be under the direction of the Pasteur Institute. On a neighbouring site an extensive institute of chemistry is to be erected at the joint cost of the State, the city of Paris, and the Paris University.

A COMMITTEE has been formed with the view of promoting investigations into the nature and etiology of pellagra, a lethal disease which has become a terrible scourge in some countries of southern Europe and in many tropical or subtropical regions in other parts of the globe. The generally accepted notion is that the disease is caused by damaged maize; Dr. Sambon has, however, brought forward cogent reasons for regarding this theory as inadequate, and has pointed out that the seasonal prevalence and distribution of pellagra are compatible with its being a protozoal disease, which is spread by the agency of blood-sucking insects, probably sand-flies. It is intended to send Dr. Sambon, accompanied by properly qualified assistants, to a pellagrous region to carry on investigations on the etiology of the disease, and for this purpose it is hoped to raise a fund of 1000*l.*, towards which several subscriptions have been received, including a sum of 150*l.* from the Colonial Office.

ALL English chemists will join with their German colleagues in offering their congratulations to Prof. Julius Wilhelm Brühl on his sixtieth birthday, which he celebrated on Sunday last. Prof. Brühl's contributions to chemical science range over the whole of the subject. His first paper, on the substitution amido- and phosphido-acids, was published in 1875, and from that year, almost up to the present, his work exhibits an almost unequalled activity. During the last thirty-five years no fewer than ninety papers have been published by this extremely energetic chemist, and it is worthy of note that, with few exceptions, they are a record of his own personal work. A paper published in 1881, on the relations of the physical properties of bodies and their chemical constitution, was the first of a long series of contributions on a part of chemistry in which Brühl stands pre-eminent. Those who were privileged to be present at the lecture he delivered in London in 1905 will remember the excellent summary he gave, in faultless English, of his work on molecular refractivity. One paper, in the domain of pure inorganic chemistry, deserves special mention as illustrating the all-round character of his work. In this research, published in 1895, hydrogen dioxide was first prepared in a pure condition, its formula was for the first time established, and its physical properties determined. Prof. Brühl has very many friends in this country; indeed, it is scarcely too much to say that all who have met him, at the British Association and elsewhere, are his friends. He has a great love for this country, and an unprejudiced respect for the achievements of her men of science. All will be glad to know that he is recovering from the severe illness which has crippled his activity for the last two years, and hope that his renewed health will enable him to add still more to our knowledge of the most difficult and perhaps the most interesting problems in chemical science.

The first fertilised eggs of the plaice for the hatching season of 1910 were skimmed from the spawning pond of the Port Erin Hatchery on February 14.

The Dutch Government is reported to have voted the sum of half a million francs for the erection of a new institute of physical and mineral chemistry, to be under the direction of Prof. F. M. Jaeger, of the University of Groningen.

Prof. J. D. Van der Waals, of the University of Amsterdam, has been elected a foreign associate member of the Paris Academy of Sciences. Prof. Van der Waals has been a correspondant of the academy since 1900.

The French Physical Chemistry Society has elected the following officers for the present year:—President, Prof. G. Urbain, of the University of Paris; vice-president, M. L. Lapicque, of the same university; treasurer, M. A. Brochet; secretary, M. Ch. Marie.

We note with regret that the *Revue scientifique* announces the deaths of Prof. H. Dufour, professor of experimental physics and meteorology in the University of Lausanne, and of Prof. Karl Gottsche, director of the Hamburg Institute of Mineralogy and Geology.

It is announced in *Science* that funds have been raised by public subscription for the establishment of an astronomical observatory at Kamuki, Honolulu, to be used in the first instance for observations of Halley's comet. The observatory, however, will be permanent, and under control of the College of Hawaii.

Prof. G. H. F. Nuttall, F.R.S., Quick professor of biology in the University of Cambridge, has been awarded the Mary Kingsley Medal by the Liverpool School of Tropical Medicine. The medal is awarded "from time to time to those who have distinguished themselves in research in tropical medicine and allied subjects."

An International Congress on the Administrative Sciences will be held at Brussels on July 27–31, in the grounds of the International Exhibition. The Secretary to the British committee is Mr. G. Montagu Harris, Caxton House, Westminster, from whom further particulars may be obtained.

The annual meeting of the British Science Guild will be held at the Mansion House on Friday, March 18, at 4 p.m. Arrangements have been made for the fellows and members of the Guild to dine together at Prince's Hall, Piccadilly, on Friday, May 6. Mr. Haldane, the president of the Guild, will occupy the chair.

A telegram was received at Utrecht on February 14 from Mr. H. A. Lorentz, stating that his expedition having the object of penetrating into Central New Guinea from the south coast has been entirely successful. Mr. Lorentz reached the snow-capped range which had previously only been perceived dimly from the distance; he has climbed in these Alpine regions, and has discovered glaciers at an altitude of 15,000 feet. One of the last geographical secrets of the tropical regions has thus been opened, and exploration in detail will no doubt follow.

Speaking at the dinner of the Physical Society on February 8, Dr. Chree, president of the society, referred to the work of the society and to its increasing activity. The number of papers read before the society has become much larger of recent years, but he thinks there may be some improvement in the presentation of such papers. Generally speaking, there are three ways in which an author may be congratulated:—first, on producing valuable results; secondly, on the form in which they are put; and, thirdly, both author and audience may be congratulated when the reading has been accomplished. Of these three, the second is the most rare. Papers usually consist of 25 per cent. due to the author and 75 per cent. of material that preceded the paper. Authors are apt to neglect the 75 per cent., and to assume that the audience know all about it; also, when any mathematics appears in a paper, the author generally proceeds to put it upon the blackboard. This is not desirable, because a physicist's knowledge of mathematics is usually not good, and mathematical results are frequently not of great value. In some ways it would be better for authors to read each other's papers instead of their own. Dr. Chree also thought it would be of great advantage occasionally if the society could have a general discussion of a subject by a physicist well acquainted with that special branch of knowledge.

In the January number of *Man* Mr. T. A. Joyce describes a remarkable wooden statue brought by Mr. E. Torday from the Kasai district in West Africa. Up to the present the art of portraiture in the round, so far as Africa is concerned, has been supposed to be confined to ancient Egypt. This specimen, however, shows that the art extended to the Bu-Shongo nation. The present statue, which is evidently a portrait, represents the national hero, Shamba Bolongonga, who is said to have been 93rd in the dynasty of rulers, the ruling king at the present day being 121st. The work is in many ways remarkable, the treatment of the collar bones and the swelling curves of the trunk displaying an attempt at realism which hitherto was supposed to be entirely foreign to the African artist. Mr. Torday, who must have displayed considerable tact and enterprise in acquiring a historical relic of this kind, is to be congratulated on his success and on his liberality in presenting such a valuable specimen to the British Museum.

Dr. C. Hose, in *Travel and Exploration* for February, gives an account of his visit to the warlike Madang tribe, occupying a region in Borneo which has up to the present remained unexplored. These people, on account of their raiding propensities, have been a terror to their neighbours; but the visit of Dr. Hose has resulted in an arrangement which will, it is hoped, put a stop to this constant intertribal warfare. It is remarkable that this race judge the fitting season for planting their rice by the sun, and they have invented a curious mode of measuring time. This is a sort of gnomon, consisting of a post about a fathom high, a piece of string weighted at each end and thrown over the top showing when the post is perfectly straight. The length of the shadow is measured by a stick marked with notches gradually approaching one another as they recede from the pole. Having got so far, it may be asked why they have never invented the sun-dial. Dr. Hose explains this by the fact that the present instrument is more efficient, as in these latitudes there are many days near each equinox when a sun-dial would be useless.

Among the contents of No. 1 of the *Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg* for 1910 is an illustrated paper, by Mr. E. Nasonow, on the life-history and transformations of *Kermes quercus*.

The sea-bass (Serranidæ) of Japan form the subject of an article, by Messrs. D. S. Jordan and R. E. Richardson, published as No. 1714 of the Proceedings of the U.S. National Museum. A new species of the large genus Epinephelus is described.

WE are indebted to the authors, the Rev. C. E. Y. Kendall and Messrs. J. D. Dean and W. M. Rankin, for a copy of a paper on the geographical distribution of molluscs in South Lonsdale, reprinted from the *Yorkshire Naturalist* for last year. The dependence of the distribution of the various species on station, geological formation, &c., is fully indicated.

IN the Proceedings of the Academy of Natural Sciences of Philadelphia for November, 1909, Messrs. H. A. Pilsbry and J. H. Ferriss continue their account of the land and fresh-water molluscs of the south-western States, dealing in this instance with the fauna of the Huachuca Mountains of Arizona. In the same issue Dr. Pilsbry, this time in association with Mr. A. A. Hinkley, discusses the Melaniidæ of the Panuco River system of Mexico.

THREE Continental insects are added to the British fauna in the *Entomologist's Monthly Magazine* for February, Dr. D. Sharp recording the Mediterranean beetle *Crepidodera impressa* from Hayling Island and *Galerucella pusilla* from the New Forest and elsewhere, while Mr. E. A. Butler chronicles the occurrence of an example of *Cyrtorhinus geminus*, a Scandinavian and Livonian hemipterid, at Broxbourne, and also mentions a second British specimen of the same species preserved in his own collection.

THE January number of the *Museums Journal* contains a summary of the correspondence which has recently appeared in the *Times* with regard to the administration of the natural-history branch of the British Museum. At the conclusion of the summary the opinion is editorially expressed that the director of the natural-history departments should be independent of the director and principal librarian at Bloomsbury. If the separation of the two establishments were carried out, no one, so far as we are aware, has suggested a suitable and adequate title for the one at South Kensington. "Natural History Museum" is obviously insufficient, except when used in connection with this country alone.

AT the commencement of a monographic revision of the Strepsiptera, published as Bulletin No. 66 of the U.S. National Museum, Mr. W. D. Pierce states that he is unable to accept the view that these parasitic insects are modified representatives of the Coleoptera, and accordingly regards them as forming an order by themselves, of which several families, in addition to the typical Stylopidæ, are recognised. In the author's opinion, the Strepsiptera form an order, "on a distinct line of descent from that of the Coleoptera, and nearer the Hymenoptera and Diptera, and as highly specialised as the highest insects in any of the orders." It is remarked that few persons have seen the adult winged males of these insects, although most collectors have marvelled at their portraits in books. The author hopes that the publication of his monograph will lead to a considerable increase in our knowledge of these insects.

To *Spolia Zeylanica* for December, 1909, vol. vi., p. 108, Dr. A. Willey contributes notes on the nest, eggs, and larvæ of the well-known fish *Ophiocephalus striatus*, locally termed in Ceylon the lula, or marral. The most interesting fact in connection with the breeding-habits of this fish is that the eggs float on the surface of the water by their own buoyancy, a feature apparently unique among fresh-water species. In certain other groups the same advantages, namely, proximity to atmospheric air and exposure to sunlight, are partly gained by the suspension of the eggs to plant-stems, their enclosure in floating nests of herbage or foam, or by their deposition in very shallow water. As regards development, the simple ventral flexure of the embryo of Ophiocephalus, the absence of retinal pigment within the egg, and the formation of the pectoral fins after the larva is hatched, are features contrasting with what prevails among many teleosteans. In these the later appearance of the ventral fins is the rule. In the African and American lung-fishes the two pairs of limbs arise simultaneously, but in the Australian Ceratodus the ventrals appear about a month later than the pectorals, much as in Ophiocephalus.

WE heartily welcome another of those meritorious monographs which the Americans are working up so thoroughly with reference to their own fauna. This time it is a "Monograph of the West American Pyramidellid Mollusks," by W. H. Dall and P. Bartsch (Smithsonian Institution, 1909, Bulletin No. 68). Though titularly devoted to the Pacific coast of the U.S.A., this work will be invaluable to all students of marine gastropods on account of its synopsis of genera and sections, forming a complete key to the systematisation of a most difficult family. It matters very little whether we accept the authors' views as to the status of their subgenera and sections or prefer to regard the majority of them as genera. Certainly many, such as Syrnola, Actæopyramis, Mormula, and Menestho, are generally nowadays accorded the higher rank—no doubt in course of time practically all their groups will be so treated. Meanwhile, Messrs. Dall and Bartsch prefer to restrict the number of recent genera, and admit only three of the four to be found in Fischer's "Manuel de Conchyliologie," Eulimella being subordinated to Pyramidella; the latter has altogether twenty-three named subdivisions, Turbonilla has twenty-four, and Odostomia has forty. So far as concerns our British Pyramidellids, the classification coincides mainly with that adopted in the Conchological Society's latest list (*Jour. of Conch.*, 1901). We note, however, several changes. The names Ondina and Pyrgostelis yield in priority to Evalea and Pyrgiscus, and the latter group, typified by the old *Odostomia rufa*, Phil., is transferred—we think more conveniently and correctly—to Turbonilla. A similar transfer is made of *O. fenestrata*, Forbes, and it is placed in a separate subgenus, Tragula. Pyrgulina is reserved for species with a sculpture of impressed spiral lines, and for our species of the *interstincta* type we must substitute the name Parthenina.

THE latest and concluding number of the ninth volume of the *Bulletin du Jardin Impérial botanique*, St. Petersburg, contains a note, by Mr. J. W. Palibin, relating to the distribution of *Adoxa Moschatellina* in the Caucasus and *Ruppia maritima* in south-eastern Siberia, and an article by Mr. A. A. Elenkin in which he presents a survey of certain species of Anabæna, with special reference to a new species, *Anabaena Scheremetiewi*.

A SECOND contribution of notes on Philippine palms, by Dr. O. Beccari, is published in the botanical section (vol. iv., No. 5) of the *Philippine Journal of Science*. The type of a new species, *Normanbya Merrillii*, is provided by a fine palm which has the habit of *Areca catechu*, and yields a nut suitable for chewing; another new species, *Areca macrocarpa*, also bears comparison with the Areca palm on account of its fruit, which is even larger than the betel-nut. Several new species are placed in the genera Livistona, Korthalsia, Heterospathe, and Pinanga; there are also additions to the climbing palms Calamus and Dæmonorops. The same number of the journal contains a first article, by Mr. O. Ames, on Philippine orchids, and a revision of the native Combretaceæ by Mr. E. D. Merrill.

THE useful and general nature of the work carried on in the West Indies under the direction of the Imperial Department of Agriculture is well exemplified in the report presented by the curator of the botanic and experiment stations in the small island of Montserrat. Experiments have been instituted in connection with the important lime-fruit industry to see what results are attained by clean cultivation. The welfare of the peasants receives attention by the provision of help and guidance in cotton cultivation and by the introduction of improved varieties of tannias and cassava, which form a staple article of food. Further, the possibilities of new products are being put to the test in the experimental plots of the wild bay tree *Pimenta acris*, lemon grasses, and *Pilocarpus racemosus*; the two former yield essential oils, while the latter is a source of the drug pilocarpine.

WITH the object of obtaining information regarding the geotropic sensibilities of stalked Basidiomycetes, Dr. F. Knoll carried out a series of experiments with *Coprinus stiriacus*, which he describes in *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxviii., part v.). A study of the longitudinal growth shows that there is a growing region at the top of the stipe or fruiting stalk where intercalary growth, due entirely to extension of the separate hyphæ, takes place. The stipes, which in the very earliest stage are ageotropic, become later negatively geotropic. Perception of the stimulus and power of response are manifested by the whole of the growing region. The variation noted in the "reaction-period" is remarkable; while the pileus or cap is young an interval of two hours may elapse between the stimulus and response, but when the spores are ripe this period decreases to a few minutes.

DR. EMIL WERTH contributes an account of the surface features of Kerguelen Island to the *Zeitschrift* of the Berlin Geographical Society. The paper is, to some extent, an abstract of the author's more complete memoir on Kerguelen published in the report of the German South Polar Expedition, 1901–3; it gives an account of the topography of the island, and discusses its relation to volcanic phenomena, past and present glaciation, and rock weathering.

THE December (1909) number of the Bulletin of the American Geographical Society contains an account of some experiments on the artificial formation of deltas, carried out in the laboratory of the geological department of Ohio State University, by Mr. Arthur L. Smith. The experiments produced two general forms of deltas, one with regularly semi-circular outline and one with irregularly lobate outline. It was found that the ultimate form of the first was determined by the maintenance of a constant or increasing stream gradient, and of the second by the decrease of the gradient of the stream. Pronounced cross-bedding was found to occur only in the fore-set layers of the lobate form, and, to a small extent, in all top-set beds. Experiment confirmed the impression, conveyed by an examination of maps of natural deltas, that "fingers" are merely surface features of the delta margin. The shape of a delta is unaffected by the depth of water or irregularities in the bed on which it is formed.

THE Kelvingrove Museum in Glasgow, which belongs to the Glasgow Corporation, contains a valuable collection of minerals, including the Glen collection, purchased in 1896, and the Fleming collection, presented in 1902. The museum is rich in the interesting minerals that have been found in the estuary of the Clyde and at other localities in western Scotland. A useful guide to the minerals in this museum has been written by Mr. P. MacNair, the curator of the natural-history collections (Glasgow: Robert Anderson, 1910, price 3*d*.). More than half the work is taken up with an introduction to mineralogy, which is more technical and advanced in its treatment than corresponding guides issued by other museums. It endeavours to carry the reader farther into the details of crystallography than most visitors to an English museum would care to follow, and the index includes many names of little importance; thus in P are Paulite, Pissophanite, Plinthite, and Protheite. The guide concludes with a brief account of the chief mineral species. It is illustrated by a plate of the interesting calcite pseudomorphs, attributed to Gaylussite, that have been dredged from the Clyde estuary.

STATISTICS of aëronautical patents in recent years are given by Dr. W. A. Dyes in the *Zeitschrift für Luftschiffahrt* for February. The number of complete patents granted in Germany was 73 in 1909, 36 in 1908, 27 in 1907, 14 in 1906. The corresponding numbers of provisional protections were 140, 48, 37, 14. In view of the fact that in Germany applications for patents are not published until the Patent Office has examined their validity, the author gives for comparison the number of applications filed by the English Patent Office in the same years, namely, 776 in 1909, 224 in 1908, 189 in 1907, 43 in 1906, and 19 in 1905.

NO better illustration of German progress in aërial navigation could be found than the long list of local aëronautical societies the official notices of which appear in the German *Zeitschrift für Luftschiffahrt*. In addition to the German Luftschiffer Verband, we have "Vereine für Luftschiffahrt" for the following districts:—Berlin, Central Rhenish, Lower Rhenish (sections at Bonn, Düsseldorf, Krefeld, Essen, Wupperthal), Pomeranian, Bremen, Bitterfeld, Lower Saxon, Brunswick, Hamburg, Saxo-Thuringian (with sections for Thuringian States, Erfurt, and Halle), Breisgau, Frankfurt, Anhalt. The Imperial Aëro Club also occurs in this list, which is based on the February number. We have nothing to correspond with these local societies in England. It must, however, be admitted that the hideous and gruesome illustration of "The Aëronaut's Death" in the January number of the *Deutsche Zeitschrift* is a little out of place in a scientific journal.

DR. F. W. EDRIDGE-GREEN read a paper on colour-blindness at the Royal Society of Arts on February 9. The paper is an excellent and lucid exposition of his well-known views upon the subject, and as such it will well repay perusal. In its general character his theory is one which is attractive to physiologists, but some of his assumptions require more impeccable evidence than is adduced. We may cite as an example the statement that "the decomposition of the visual purple by light chemically stimulates the ends of the cones (very probably through the electricity which is produced)." His strictures of the tests for colour-blindness in common use have at least sufficient foundation to demonstrate the need for their reconsideration as a part of the reformation of the official examinations.

THE November (1909) number of the Bulletin of the Bureau of Standards contains a paper, of nearly fifty pages, on platinum resistance thermometry at high temperatures, by Messrs. C. W. Waidner and G. K. Burgess. They find that temperatures determined on the pure platinum resistance scale standardised at 0°, 100°, and at the boiling point of sulphur, taken as 444·70° C., agree with temperatures on the gas thermometer scale in the interval 0° to 1100° C. within the limits of experimental error of the latter scale. With impure platinum, for which the constant δ of Prof. Callendar's interpolation formula differs from 1·5, the value of δ has to be taken as increasing with temperature by an amount which increases with the degree of impurity before agreement with the gas scale can be secured. With the pure palladium thermometer even this is not sufficient. In neither case is the interpolation formula proposed by Mr. J. D. H. Dickson found suitable. High temperature appears to render the impure platinum purer, possibly by evaporating impurities, as, for example, iridium. The authors consider it desirable that thermometers should be standardised at a fourth point in addition to the three mentioned above, and suggest that the freezing points of metals, even when only commercially pure, are now known with sufficient accuracy, and are so easily reproduced, that they furnish convenient fixed temperatures. They give the following figures for the freezing points:—tin, 231·92°; cadmium, 321·01°; lead, 327·43°; zinc, 419·37°; antimony, 630·71°; aluminium, 658·0°; silver, 960·9°; copper, 1083·0°; the 72 per cent. silver, 28 per cent. copper eutectic, 779·20°.

H.M.S. *Collingwood*, the latest of our Dreadnought battleships, has just completed her official steam, gunnery, and torpedo trials, a brief account of which appears in the *Engineer* for February 11. The *Collingwood* is the sixth ship of her class floated, and was launched from Devonport Dockyard on November 7, 1908. The machinery is of the Parsons turbine type, and there are two complete sets, each set comprising one high-pressure ahead and one high-pressure astern turbine; one low-pressure ahead turbine, in which is incorporated one low-pressure astern turbine and one cruising turbine. The boilers are of the latest improved large-tube Yarrow type, adapted for either coal or oil fuel. During the speed trials the powers specified were easily exceeded, and although the sea was very rough while the battleship was run over the measured mile at Polperro, the designed speed of 21 knots and the specified shaft-horse-power of 24,500 was realised. Other trials included 30-hour runs at 20 and 70 per cent. of the full power, and eight hours at full power. The machinery was constructed by Messrs. R. and W. Hawthorn Leslie and Co., Ltd., the order having been promptly executed despite seven months' lost time during the engineers' strike on the north-east coast.

THE first part of a general description of the engineering and constructional features of the Panama Canal, by Mr. G. W. Goethals, chairman and chief engineer of the Isthmian Canal Commission, appears in *Engineering* for February 11. Among other interesting items, we learn that dynamite is used for blasting, as excessive moisture and water in the holes prevent the use of blasting powder. An average of 1,000,000 lb. of dynamite per month is consumed for the entire work, and the number of accidents has been relatively small, although, owing to the number of men in contracted areas, the casualties have been great. Premature explosions, attributable to concussion during loading, led to the substitution of pine-rammers for those of lignum vitæ. Temperature tests are made prior to loading, as in some cases high temperatures exist in the holes. Unexploded charges, subsequently dug out by steam shovels, led to laying wires direct from electric-lighting plants to the cut in substitution for the ordinary magneto-electric machines operated by hand. The fuses are connected in parallel in lieu of in series, failures often occurring in the latter case, none in the former. No holes are now loaded which cannot be fired the same day, a precaution necessitated by the premature explosion of 22 tons of 45 per cent. dynamite at Bas Obispo, probably owing to some of the nitroglycerine having been liberated and exploded by concussion by a dobie shot in the vicinity. Accidents have occurred during electric storms, and the only possible precaution is now taken by stopping work.

THE evidence given at the Board of Trade inquiry into the Stoat's Nest accident on the London, Brighton and South Coast Railway shows that the left-hand leading wheel of the coach which left the metals had been displaced from its true position on the axle by about one inch. This would be quite sufficient to cause an accident if the wheel had previously shifted, and there is reason to believe that this was the case, as the signalman had seen sparks flying from the bogie frame near this wheel before the accident occurred. Commenting on the evidence, *Engineering* for February 4 points out that in many cases too much reliance is put on the men in charge of the work of pressing wheels on to the axles. A great deal of care is taken by the railway companies, and only experienced men are chosen for this work; but the foremen cannot witness every operation, and there may be a tendency for workmen to pass wheels which have been pressed on at figures barely reaching the required limit. The pressure used in the case of the wheel above mentioned was stated in evidence as sixty tons. It is of interest to note that, at the Horwich works of the Lancashire and Yorkshire Railway, an autographic record is drawn by the press during each operation. Such a record is invaluable as a check on the workmen, and enables the foreman to deal promptly with cases of poor work before the wheels leave the shop. The *Engineer* for February 4, commenting on the accident, says that facing points as now constructed are not dangerous, and that diamond crossings are a source of danger. It is suggested that the accident may have been caused by the wheel, which was wide to gauge, striking the diamond crossing which exists at the place where the accident occurred.

PROF. W. H. HUSSEY contributes to the January Bulletin of the American Mathematical Society tables of Galois fields of order less than 1000.

IN the *Rendiconto* of the Naples Academy (3), xv., 3, 4, Dr. Paolo Rossi discusses the nature of the secondary radiations of X-rays and their dependence on the substance which emits them. A property is referred to, analogous in some respects to Stokes's law of fluorescence.

MESSRS. HOEPLI, of Milan, have issued the fifth and last volume of Brioschi's collected mathematical works, at the price of 30 francs. This volume contains papers contributed to French, German, and English mathematical and scientific journals.

MESSRS. JOHN WHELDON AND CO., of 38 Great Queen Street, Kingsway, London, have issued a classified entomological catalogue, comprising some 1400 books and papers they have on sale. We notice that the list includes some recent purchases and selections from various entomological libraries.

THE ten numbers of the "Bulletin of Miscellaneous Information," issued during 1909 from the Royal Botanic Gardens, Kew, and noticed already from time to time in NATURE, have been published in volume form. Like other Government publications, the book may be obtained, directly or through any bookseller, from Messrs. Wyman and Sons, Ltd., Fetter Lane, London. Its price is 3*s*. 6*d*.

A SECOND edition of Prof. Wilhelm Ostwald's "Grosse Männer" has been published by the Akademische Verlagsgesellschaft of Leipzig. It will be remembered that the first edition of the work was reviewed at length in our issue of July 29, 1909 (vol. lxxxi., p. 121). The price of the volume is 14 marks.

OUR ASTRONOMICAL COLUMN.

COMET 1910*a*.—Reports received from various observers show that at the beginning of this week comet 1910*a* was no longer a striking naked-eye spectacle, and there is little that is new to record regarding it.

Mr. Gustave Gillman sends us a fine drawing showing the comet's position and the extent of its tail as seen by him at Aguilas, Murcia, Spain, on January 27 and 31. For the former date the drawing, which is a large-scale chart of the region of stars wherein the comet was then located, shows, distinctly, the tail extending to ζ Pegasi, making its length more than 20°; but unfortunately the chart is unsuitable for reproduction here.

In *La Nature* for January 29 (No. 1914) M. Lucien Rudaux describes the comet as seen from Paris on January 21 and the succeeding days, and a drawing shows that it had a brilliant nucleus and a well-developed tail, several degrees long, on January 22. A number of observations are also recorded in the *Gazette astronomique* (No. 26), where attention is directed to the fact that if the apparent length of the tail on January 30 were 30°, the actual length was something like 110 million kilometres (68·75 million miles).

A number of drawings and photographs of the comet were shown at the meeting of the Royal Astronomical Society held on February 11. Among other remarkable features were the development of a shorter tail on the southern edge of the main tail, near the head, and the considerable extension of the main tail at its N.E. extremity; this extension curved quite abruptly from the main axis, and reached nearly to γ Pegasi. Mr. Hinks, who showed a number of drawings, directed attention to the fact that the bright nucleus was situated on the extreme inner edge of the head, so that the two branches of the tail appeared to enwrap it completely on the sunward side. The drawings also depicted the zodiacal light, with which the tail appeared to merge, thus forming a magnificent spectacle. Observations are also recorded in No. 6 of the *Comptes rendus* (February 7). MM. Luizet and Guillaume state that on January 29 and 30 the tail was 30° long, and, at a distance of 15° from the nucleus, its breadth was 2°; on January 31 it was distinctly fainter. MM. Javelle, Charlois, and Schaumasse report that on January 25 the nucleus was round and $10''$ in diameter, and two aigrettes, symmetrical with regard to it, were distinctly seen. On February 1 the comet was sensibly fainter, and the aigrettes were no longer visible, whilst a further diminution of brightness was recorded on February 2, and the nucleus was seen to be elongated. M. Borrelly records that on February 3 the side of nucleus nearer the sun was nearly devoid of coma.

THE MAGNETIC STORM OF SEPTEMBER, 1909, AND SOLAR PHENOMENA.—The connection between the magnetic storm of September 25, 1909, and the contemporaneous solar phenomena observed at the Meudon Observatory is discussed by M. Deslandres in a paper which appears in No. 2 of the *Comptes rendus*. A spectroheliogram of the upper hydrogen atmosphere, on September 24 4h. 35m. p.m., shows strong dark *filaments* connected with the spots, the areas of the latter being greatly diminished. At 9h. 3m. a.m. on September 25 these *filaments* had nearly disappeared, and were broken up, and M. Deslandres connects this phenomenon with that of the magnetic storm. A photograph of the "mean layer" of calcium on September 24 shows the eastern spot to be bordered, on its eastern side, with alternate bright and dark filaments, polygonal in form and sharply defined, and a number of similarly shaped flocculi join the two spots. M. Deslandres names this special structure *le réseau chromospherique*, and supposes that it shows the region on the western side of the spot to be in a fairly calm state. Photographs taken for that purpose, on September 24, give no evidence of motion in the line-of-sight, but show the bright vapours above the eastern spot discussed by Dr. Lockyer.

M. Deslandres discusses the several theories as to the solar-terrestrial connection, and shows that the "kathode radiation" theory may explain many of the phenomena. The kathode rays leaving the spot are curved, by the exterior magnetic field of the sun, like the spires of nebulæ, and this may account for the mean "lag" of forty-five hours between the meridian-transit of the spot and the incidence of the magnetic storm. The "whirls" of Prof. Hale thus become the effect, rather than the cause, of the magnetic field, which by M. Deslandres's theory is produced by the corpuscles circulating round the sun with great velocities. The difference between the calcium and hydrogen images is also explained by this theory, for the action of the field would produce different results on atoms of different masses.

THE INTRINSIC LIGHT OF THE SKY.—An interesting method of comparing the intrinsic light of various parts of the sky *inter se* and with stars of known magnitude is described by M. Ch. Fabry in a paper appearing in No. 5 of the *Comptes rendus* (January 31, p. 272).

In the focal plane of an objective of 48 cm. focal length M. Fabry placed a circular diaphragm of variable aperture. Passing through this aperture, the light of the sky fell upon an optical system, of 3·15 cm. focal length and large aperture, which projected an image of the objective on to a photographic plate. Thus the plate registers, as a uniformly illuminated circular area, the whole of the light coming from that part of the sky of which the image is formed behind the diaphragm. In making a determination, two exposures are necessary:—(1) the camera is directed to a star, *e.g.* Polaris, and the diaphragm is closed down so that only the light from the star is allowed to reach the plate; (2) the camera is directed to the region of the sky to be investigated, and the diaphragm opened so that an exposure of equal duration will give an image of equal density to that produced in the first case; a simple calculation then gives the ratio between the intrinsic illumination of the area under consideration and the light of the chosen star.

By this method M. Fabry finds that a square degree of sky, in galactic latitude 30° and near the pole, gives a photographic intensity equal to 0·103 that of Polaris, or 0·92 that of a fifth-magnitude star. The corresponding ratios for an area, of one degree square, between β and γ Cygnus, one of the brightest regions of the Milky Way, are 0·212 and 1·9 respectively. These values differ from those obtained by visual observations, probably because the magnitude of Polaris was taken as 2·62, but if the visual magnitude of the latter is taken, 2·12 on the Harvard scale, the result for 1 square degree of non-galactic sky is 1·46 of a fifth-magnitude star, a value intermediate between those obtained by Newcomb (1·15) and Burns (2·0). As regards the ratio between galactic and non-galactic sky, M. Fabry's results are in accord with the visual observations.

ELLIPTIC ELEMENTS AND AN EPHEMERIS FOR DANIEL'S COMET, 1909*e*.—From observations made at Rome and Nice on 1909 December 8 and 1910 January 2 and 14, Dr. Ebell has calculated elliptic elements for the orbit of Daniel's comet, 1909*e*, which he publishes, with an ephemeris, in No. 4384 of the *Astronomische Nachrichten* (p. 264). The elements give 1909 November 28·91228 (Berlin) as the time of perihelion passage, and 6·403 years as the period, but they are not yet considered final. According to the ephemeris, the comet is now (February 17) 58m. east and 38′ north of δ Aurigæ, and is only about one-fifth as bright as it was on December 8; its daily motion is slightly less than 2m. nearly due east.

PUBLICATIONS OF THE LUND OBSERVATORY, SWEDEN.—From the Lund Observatory, Sweden, we have received three papers, published as *Meddelanden från Lunds Astronomiska Observatorium*. No. 5 (series ii.) is by Prof. Charlier, and discusses the motions of the orbit-planes of satellites in various planetary systems. In No. 6 M. Henrik Block discusses a class of singularities in the problem of *n* bodies, and in No. 40 (first series) Dr. Zinner treats of the secular perturbations in the planetary rotation problem.

IMPROVEMENTS IN RESILIENT WHEELS FOR VEHICLES.

AT a meeting of the Royal Society of Arts held last December, the Hon. R. Clere Parsons gave a brief history of the improvements which had been made from time to time in the wheels of vehicles, which had resulted in the extensive adoption of the pneumatic tyre, and then passed on to describe a spring wheel which possesses practically all the advantages of a pneumatic-tyred wheel without its heavy cost of maintenance and liability to puncture.

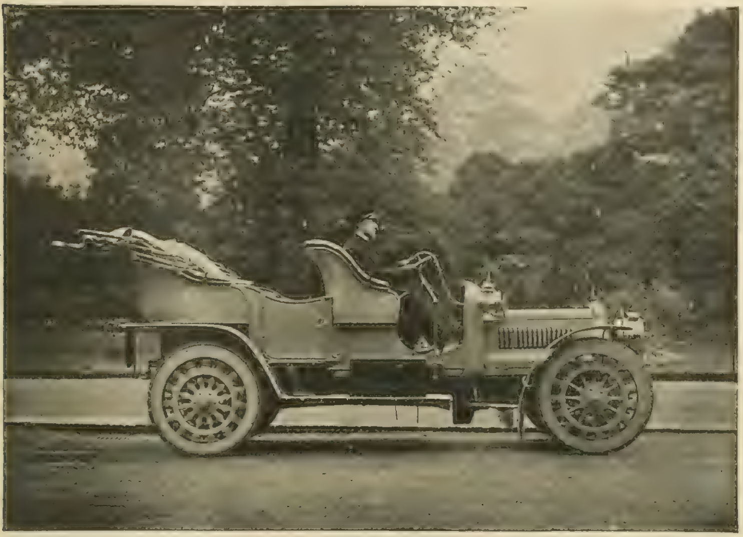
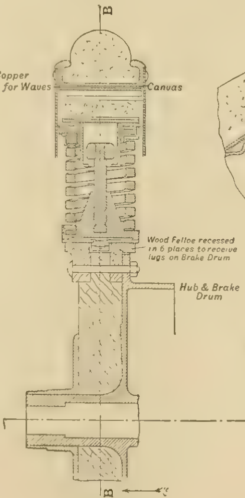


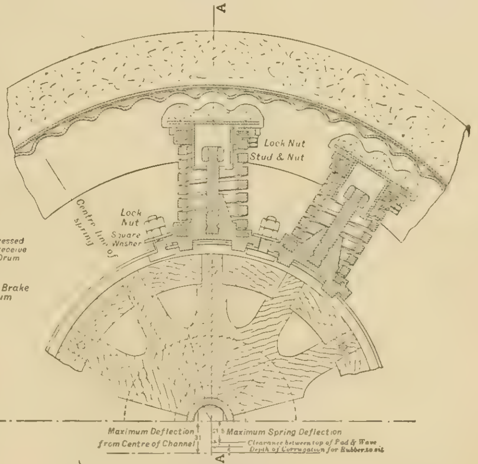
FIG. 1.

The author explained that, before he attempted to design a spring wheel, he had made a careful search through the records of the British Patent Office Library with the view of ascertaining, if possible, why the numerous inventions relating to this question had not been successful. This search led him to believe that if certain principles were adopted, and careful investigations made, there was a prospect of obtaining a trustworthy spring wheel, which as yet had not been produced.


B
Copper Rivets for Waves
Canvas
Wood Felloe recessed in 6 places to receive lugs on Brake Drum
Hub & Brake Drum
B

Section AA.

FIG. 2.


A
Lock Nut
Stud & Nut
Centre line of Spring
Lock Nut
Square Washer
Maximum Deflection from Centre of Channel
31
Maximum Spring Deflection
Clearance between top of Pad & Wave
Depth of Corrugation for Rubber to sit
A

Section BB.
looking in direction of arrow

FIG. 3.

The preliminary investigations were made with model wheels 12 inches in diameter, which were tested in the apparatus he described, and in which the effects of the jolts imparted to the wheel were automatically recorded. The result of these investigations indicated that it was possible to substitute spiral steel springs for the air spring of the pneumatic tyre, and at the same time retain practically all its resilient properties.

This special type of wheel, which is known as the "Pan-flex," from its being flexible in all directions, was then carefully designed, and a set fitted to a 28–30 horse-power Daimler touring car, illustrated in Fig. 1, which in running order weighed 2 tons 5 cwt.

The wheel, illustrated in section and elevation in Figs. 2 and 3, consists of a steel channel rim similar to those used for solid rubber tyres, and into which a rubber tyre is inserted. On each side of this channel rim are rivetted annular plates, so as to form an internal channel, in the bottom of which are corrugated transverse projections. To the wheel centre are rigidly fixed spiral springs at regular intervals, which project radially outwards, and to their extremities are attached rubber pads formed with transverse undulations. The diameter of the wheel centre over the pads of the springs being slightly less than that of the channel rim, the wheel centre can be inserted therein, but is not connected in any way with it. The wheel is then complete and ready to be used on a vehicle.

The action of these wheels is simple, and merely consists of the pads on the ends of the spiral springs, as it were, acting as feet, which walk round inside the outer rim, and in turn support the weight of the vehicle. The wheel centre, when the vehicle is travelling along, rotates slightly more rapidly than the outer rim, the advance of the one upon the other being termed the "creep." When any obstacles are passed over, the shocks imparted to the rim of the wheel, which would, if it were a solid one, be transmitted through the axle to the machinery and car body, are absorbed by the rubber pads and springs before they reach the wheel centre. The principle and details of this wheel are quite novel, as has been admitted by the German Patent Office experts previous to granting the patent.

Owing to the rubber caps at the extremities of the spiral springs being capable of deflecting in all directions within certain limits, the friction of the moving parts of the wheel is negligible, and, as a result, practically no heating occurs, consequently the wear and tear is exceedingly small. The spiral springs attached to the wheel centre are designed so that in no case can they be subjected to a strain in any direction whichever approaches their limit of elasticity; consequently, provided no flaw exists in the steel of which they are made, their life should be indefinitely long. If, however, from any cause a spring should break, no inconvenience is felt, as the journey can be completed, and a fresh spring can then be fitted in about five minutes.

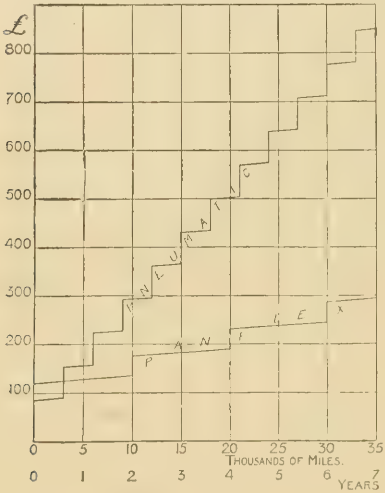


Fig. 4.

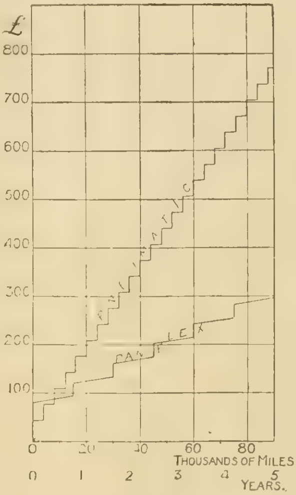


Fig. 5.

The repairs of the "Panflex" wheel merely consist of the renewal of the solid rubber tyre, which can be effected by a coach-builder, and probably an occasional rubber pad or spring, a few of which should be kept in the car. The wheels have been tested on the Daimler car for 4000 miles, and the results indicate that the perishable parts should endure at least 10,000 miles.

These wheels have also undergone very severe tests on a taxi-cab in the streets of London and the suburbs for the last three months with very satisfactory results. The first cost of the "Panflex" wheel is somewhat greater than that of a pneumatic-tyred wheel, but the expenditure on maintenance is much less, as is shown by the diagram exhibited by the author (Figs. 4 and 5), which indicates the saving in maintenance of each car, as regards tyres, by the use of "Panflex" wheels.

In conclusion, the author enumerated the advantages possessed by the "Panflex" wheel, and explained that by its adoption the use of the motor-car could be brought within the reach of persons who are now precluded from availing themselves of it owing to the excessive cost of maintenance of the tyres.

THE SPECTRUM OF THE ZODIACAL LIGHT.

SINCE the time when Cassini published his observations of the Zodiacal Light, in 1682, the question as to the nature and origin of this peculiar phenomenon has been constantly recurring. Visual observers were ever at variance on the subject, some holding the view that the Light was a terrestrial adjunct, others that it was a solar appendage. Visually, the matter is a difficult one to decide, for no optical power may be used because of the lack of contrast between the Light and its background of sky. Photography is similarly placed out of court, but it was expected that the question would be solved by the spectroscope. This expectation has never yet been realised absolutely, but the results recently published (Lick Observatory Bulletin, No. 165) by Dr. Fath clarify matters considerably.

Previous spectroscopic observations have varied on a vital point, viz. the presence or absence of bright radiations in the spectrum, indicating, by their presence, that the Light was self-luminous. Thus some observers found that the spectrum was continuous, others found that its continuity was broken by bright bands, especially the bright aurora line at λ 5571. The argument for the presence of the latter as an inherent element of the spectrum was, however, considerably weakened, if not eliminated, by the observations of Respighi, Vogel, Piazzi-Smyth, and others, who were unable to find the aurora line, when observing the spectrum of the Zodiacal Light, unless it was at the same time to be seen in all parts of the sky. Tacchini, Cacciatore, and Ricca similarly were unable to find it, but agreed that the spectrum was continuous, extending from about λ 5000 to λ 5550, with its maximum intensity at λ 5350; that is to say, the spectrum of the Light resembled the solar spectrum without the absorption lines.

The detection of the dark solar lines is a difficulty inherent to the observation, for the Light is so faint that, to get a visible spectrum, a broad slit is essential, and with a broad slit the comparatively fine absorption lines are lost.

Wright, in 1874, was able to use a narrower slit, and found that the spectrum, with an intensity-curve similar to that of daylight, showed traces of an absorption band in the position of the δ band in the solar spectrum.

Thus it became fairly evident that the Zodiacal Light was reflected sunlight, and the opinion now generally held is that it is reflected by a collection of small meteoritic bodies surrounding the sun; this theory is supported by the observation that a fair percentage of the light is polarised. The recent observation of Prof. Fowler (Nature, vol. lxxxi., p. 396, September 30, 1909), who, during an auroral display, was able to detect the aurora line everywhere, "even in the light reflected by a pocket-handerchief," illustrates the danger of attributing the auroral radiation to the spectrum of the Light, simply because it is seen contemporaneously.

To decide the question of the spectrum of the Light, photographic observations, if possible, were desirable, and, in 1883, Mr. Michie Smith attempted the task of photographing it, but was unsuccessful. Now, however, Dr. Fath has succeeded in obtaining a photograph after exercising a great deal of care and ingenuity in overcoming the numerous difficulties.

The first attempts were made, at the instigation of Prof. Campbell, in 1907 at Mount Hamilton. The spectrograph was especially designed and constructed for this research, and has an aperture of 51 mm.; the focal length of the collimator is 814 mm., and that of the camera is 154 mm. Rigidity, to withstand flexure or distortion over long periods, is the main feature of the frame, which is made of well-seasoned pine 13 mm. thick, shellaced inside and out, and put together with glue and screws. The prism is of light flint having a refractive index of 1·611 for $H\gamma$, and was set for the minimum deviation of this ray; the resulting spectrum is about 2·2 mm. in length from λ 5000 to λ 3900.

In the autumn, when the Zodiacal Light appears in the morning above the eastern horizon, less than one hour before sunrise is available for the exposures, which therefore have to be accumulative. As the altitude of the Lick Observatory is 1283 metres, it was expected that dawn might commence before the zenith distance of the sun was 108°, the usually accepted value, and in the first experiments the exposure was always stopped when the computed zenith distance was 111°; later experiments showed this precaution to be unnecessary.

In August, 1907, an exposure was made, over the period August 8 to 15, totalling 6h. 1m., and in the very faint spectrum secured absorption lines at λ 4300 and λ 3950 were suspected.

A stronger spectrum was obtained in October, 1907, with a total exposure of 11h. 9m., but still the traces of absorption were too faint to permit of any definite conclusions. Another attempt in the autumn of 1908 only served to illustrate the numerous pitfalls awaiting the observer of this evanescent spectrum. Jupiter and Venus were above the horizon, reflecting sunlight, and this so complicated matters that the experiments had to be abandoned.

On his translation to Mount Wilson, Dr. Fath resumed the inquiry, and, by the courtesy of Prof. Campbell, was able to use the same instrument. Elaborate precautions were taken to eliminate any chance of "shift" caused by the vibration or change of temperature of the spectrograph; the instrument was also mounted on an azimuth slide, so that it could be moved in azimuth some 5°, in order to follow the brightest part of the Zodiacal Light. The width of the slit employed was 0·41 mm., and at this width the solar lines H and K are not separated in the spectrum. The exposures extended from 1909 September 12 to September 25 under very favourable conditions, and were always arrested a minute or two before the time calculated for the zenith distance of the sun to be 108°. Careful watch was kept for any abnormal dawn or other phenomena which might vitiate the results, but none was observed.

With a total exposure of 12h. 31m., on a Lumière "Sigma" plate, a spectrum was obtained, under these conditions, which, so far as its small size will allow one to judge, resembles the solar spectrum exactly. Two absorption lines are certainly seen, and a comparison spectrum of daylight shows these to be G and a blend of H and K in the solar spectrum. There are no signs of bright lines on any one of the spectra obtained, and therefore, as Dr. Fath concludes, we seem justified, so far as such small, impure spectra can lend justification, in concluding that the Zodiacal Light is nothing more than reflected sunlight.

To support this conclusion it is, of course, desirable that the work should be continued, using a narrow slit to obtain greater purity of spectrum; but this entails the employment of much quicker plates than are at present available, or a much longer exposure. The latter is at present probably the most feasible plan, but when one remembers that the hours of exposure must be moonless, planetless, and clear, it is obvious that several months would be necessary to complete one such exposure. This means that special precautions to secure the constancy of the spectrograph would be necessary, and Dr. Fath suggests the construction of one with a metal frame, which would be less likely to suffer change than a wooden one, and could be maintained at a fairly constant temperature.

W. E. Rolston.

TECHNICAL EDUCATION IN GERMANY AND THE UNITED KINGDOM.

At the request of Mr. R. Blair, the executive officer of the London County Council Education Committee, a valuable memorandum has been drawn up by Dr. F. Rose on the qualifications of the students trained at the German technical high schools in comparison with those of students at British universities and technical institutions of university rank. This memorandum, with the tabular portion abridged, is subjoined, and it contains facts of great interest and importance. Referring to it, Mr. Blair says:—

"The memorandum shows that one or two broad statements of fact may be made, and these deserve, if they do not demand, attention. First, the schools of the United Kingdom do an immense amount of valuable work in the evening—my own view is that the work is unparalleled. So much further education in the evening is partly due to the fact that a life of earning and independence begins earlier in the United Kingdom than in Germany, and is partly an indication of the inadequacy of the day work in these islands. It is hardly possible—and I have not attempted to do it—to assess this evening work in such a way as to place it side by side with the day work in the United Kingdom in comparing the latter with German day work, and such a comparison would also have required an appreciation of the evening work in Germany. But it has much value. Secondly, taking, as far as one can, comparable institutions, there are 12,000 fully qualified students attending day institutions for the highest technical training in Germany, and only about 3600 in the United Kingdom. The German courses are, speaking generally, longer and the previous preparation better. Further, this great difference in quality and quantity of the work done has existed for more than a generation; and these highly qualified German students have found, and do find, their way into agriculture and industry, because the German people believe in the application of trained intelligence to all forms of national activity."

Dr. Rose's report, in an abridged form, is reprinted below.

Although there is little doubt that the majority of students trained in German technical universities actually take up industrial positions upon leaving, it is impossible to give any detailed information, as no statistics on the subject have been published or are obtainable. Nine years ago I carried out an investigation to show to what an extent the German chemical industries had benefited from the chemical instruction available at universities and technical universities. The proportions still hold good for the present day, although the figures have increased. It was found that there were about 4000 academically trained chemists in the different branches of the chemical industry. The value of the annual production of the chemical industries was estimated at 50,000,000*l*.

The total number of chemists trained in Germany was estimated at the same time at about 7000. It would not be going too far to say that at least four-fifths of the German students actually take up positions in industries and technical work when they leave the technical universities; a very large number of the fully qualified students pass the final diploma examinations.

No account has been taken of the non-fully qualified students, who amount to about 10 or 15 per cent. more. A great many of these students also take up technical positions. In a large number of cases they are the sons or relatives of engineers and manufacturers who, before taking over the family works, wish to study a certain amount of technical science without submitting themselves to the drudgery of an examination.

Although it is almost a matter of impossibility to compare German technical universities with the applied science faculties and departments of English universities and with English polytechnics and technical colleges, an attempt has been made to do so in the tabular statement [here abridged so as to include totals only] given below. The difficulty of comparison arises from the fact that the German technical universities are independent technical institutions, and are organised throughout on a high level and on a uniform scale.

Technical Education in Germany and Great Britain—Educational Year, 1907–8.

Institutions	Number of fully qualified day students (German technical universities). Students taking full courses (English institutions).	Number of non-fully qualified day students (German technical universities).	Number of evening students.	General ages of day students.
GERMANY—				
Ten Technical Universities	11,692	2,299		18 or 19 to 24 and 25 and over Minimum age, 18
UNITED KINGDOM—				
Twenty-three Universities and Colleges of University rank	3,607		16,623	Entrance age, about 16
Eight London Polytechnics, and Technical Schools at Birmingham, Bolton, Leicester, Derby and Salford	461		25,574	Entrance age, about 15

Some of the points of difference may be mentioned. The matriculation for fully qualified students at German technical universities is the completion of the full nine years' secondary-school course at a classical, semi-classical, or modern secondary school. This practically amounts to a B.A. pass degree, say, at Oxford or Cambridge. There are, however, a few exceptions here and there, but they scarcely affect the almost general rule. At English institutions it is in most cases impossible to get any detailed or uniform information on this point, but it is clear that the standard of previous educational qualifications, even at many institutions of university rank, is lower than in Germany. This explains why German students do not commence work at the technical university before eighteen or nineteen, whereas at most English institutions the minimum age limit is sixteen, or there is no limit at all.

The next striking difference is the fact that there are no evening students at German technical universities, whereas in English institutions there are generally more evening students than day students.

Another point of difference is the length of the technical courses. As a rule, these last at least four years in Germany, and most students add one or two additional terms (half-years) to this period. In England the average length of the courses is less in most cases.

With regard to diplomas and degrees, the German procedure is simple and uniform at all the technical universities. The student who has successfully passed through his course of study and passed the necessary examination is awarded a diploma in his special branch. This is sufficient for the needs of the average engineer or manufacturer. If the diploma holder, however, wishes, he can spend one or two years more in research work connected with his particular branch, and can then obtain the degree of doctor of engineering by presenting his thesis and passing a further examination. This arrangement is practically uniform at all the technical universities. English scientific degrees and diplomas, however, are so diverse and numerous that it is almost useless to try and compare them with the German ones.

In addition to the simple diplomas and degrees there are other examinations which must be taken into consideration in dealing with German technical universities. These are the State examinations for State positions in State railways, mines, forests, canals, domains, smelting works; Government building, engineering, and surveying; teaching (secondary schools), post, telegraph, &c., Customs, shipyards, river and coast regulation, pharmacy, food inspection, and so forth. All candidates for these examinations must, of course, be fully qualified students.

The majority of high Government technical officials pass through the classical gymnasia before entering the technical university. The Government examination is, as a rule, more severe than the diploma examination undertaken after a four years' course at some technical universities. The diploma examination is accepted in some parts as equivalent to, or as the first section of, the official State examination for State technical positions. When the numbers of students who pass the diploma and State examinations are compared with the number of students actually at work at a technical university, it will be seen how large a number of German students complete full technical courses and pass the necessary examinations. It should also be mentioned that the majority of German technical universities exact about one year's previous practical work from fully qualified students entering their technical departments. No officials and no persons engaged in the purely commercial aspects of trade may enter as fully qualified or non-fully qualified students.

The German technical universities differ from English institutions, not only in the quality, variety, and length of their technical courses, but in the time devoted to work per day. It does not appear that the whole day is devoted to work at most English institutions. Whilst some work as much as 1000 hours per year, others work less. A minimum of 300 hours has been set up by the Board of Education for statistical purposes. At German technical universities the whole day is devoted to work, and lectures commence at seven in the summer and at eight in the winter, all the remaining time being devoted to work in drawing offices and laboratories.

The final point of difference is that the German technical universities only exist for the purpose of teaching applied science, whereas in England departments for this subject have been grafted upon universities with faculties for science, letters, medicine, law, theology, and so forth. Pure science is, of course, taught at all the older German universities in departments of the philosophical faculties.

No account has been taken in the comparison of the German mono-technical schools—that is to say, technical schools which contain only one, or perhaps two, technical departments, and which admit students about the age of fourteen or sixteen for technical courses lasting from two to four years. Such schools, which may be termed secondary technical schools, provided with fine buildings, full technical equipment, and properly staffed, number about two hundred.

A very large number of technical schools for special branches of trade exist. Such schools have been established for milling, boot-making, tanning, musical instrument making, toy-making, book-making, photography, &c. There are also numerous schools for applied art. It is very difficult to get these schools into line for purposes of comparison. They are of two types, higher and lower; there is a certain amount of overlapping, and the conditions are not uniform. They are in extremely close touch with the industries concerned, and have been founded and developed in their midst. The difference between the technical universities and the best of the technical schools mentioned above may be briefly summed up in the following table of comparison:—

Subject of comparison	At the ten technical universities	At the special engineering schools and other technical schools, with courses in mechanical engineering, building and electrotechnics, &c.
Lowest entrance age	18 years	14 and 16 years
General ages	18 to 25 years	14 or 16 to 30 years
Necessary degree of previous education	The completion of the full courses (9 years) of a gymnasium or full "real" school, making, together with the three years at a preparatory school, a total of about 12 years	Qualification for the one-year military service; (6 years at a secondary school); also completion of the "Volkschule" (elementary school) and a knowledge of mathematics and some years' practical work
Scope and manner of instruction	Advanced and complete application of higher mathematics and mathematical sciences advanced theory and design, facilities for the attendance of lectures in the departments of chemistry, civil engineering, architecture, art, science and literature	A certain measure of instruction complete within certain limits, specially arranged for practical requirements, no higher mathematics, elementary theory and design; no facilities for instruction in other technical departments or in letters, languages, philosophy, &c.
Aim of the instruction	Training of experts, great inventors, high technical State and municipal officials, "captains of industry," owners and managers of great works, professors, secondary teachers, consulting men of science, engineers, architects, chemists, patent agents, &c.	Training of owners and managers of smaller works, foremen, clerks of works, surveyors, minor State and municipal officials, draughtsmen, technical travellers, &c.
Previous period of experience in works	Generally 1 year as minimum, with a tendency to increase	2 to 4 years as minimum, 2 years being exacted almost without exception; very strictly observed
Length of courses ..	4 years in almost all cases, with a tendency to increase	2 to 2½ years, sometimes 1½ years, in rare cases 3 and 3½ years
State and municipal technical appointments open to students who have completed the courses	Higher appointments in the State and municipal technical services	Lower appointments in the State and municipal technical services
Attendance at lectures	No compulsion... ..	Obligatory

Although English universities have been included in the comparison, no mention has been made of the following German institutions of equal or similar rank:—

The twenty older universities (excluding the theological universities of Braunsberg and Münster)	They contain 48,000 students. Of these a large number study chemistry, which is a department of the faculty of philosophy at all German universities
The three agricultural high schools	Same educational qualifications as at the technical and older universities. Exceptions, however, are allowed. Number of students=1402
Agricultural departments	At seven of the older universities and at one technical university
The five veterinary high schools	Same educational qualifications as at the technical and older universities. Number of students =1321
The four forestry academies	Same educational qualifications as at the technical and older universities. Number of students =262
The forestry departments	At three older universities and one technical university
The three mining high schools	Same educational qualifications as at the technical and older universities. Number of students =791
Various	A mining department at Aix Technical University. A veterinary department at Giessen University

The result of this comparison between German and British technical institutions shows that the former are constituted and organised on a higher level. With the possible exception of the Imperial College of Technology and applied science departments at Cambridge, Edinburgh, Glasgow and Victoria Universities, Trinity College, Dublin, and some university colleges, there do not appear to exist in the United Kingdom technical institutions which can be compared with any of the great German technical universities.

Looked at from the basis of the German standard of previous education and practical work, length, extent, and variety of the courses taken, and the number of diplomas granted, it will probably be found that there are insufficient students in the whole country to fill one of the large German technical universities. Here and there a number of students in a few departments come up to the German level. Good technical institutes and departments in England appear to be more on a level with the best technical schools in Germany rather than with the technical universities. Such schools are, for example, the Prussian higher mechanical engineering schools at Dortmund, Elberfeld, Breslau, and Cologne, the trade academy at Chemnitz, the technical school at Cöthen, and several "Technikums." These schools do not admit students before sixteen, require a six years' certificate from a secondary school and proof of two years' practical work, and have a course of at least two years. They are very numerous in Germany.

In England the tendency during the last ten years has been to graft departments for higher applied science upon the older or modern universities. This was done in Germany very many years ago and soon abandoned. For example, engineering was once taught at Giessen University, higher mechanics at Munich University, and technology at Göttingen and other universities. At the beginning of the nineteenth century lectures on technology were given at Heidelberg, which were suitable in every respect for a technical school. Building, mining, metallurgy, forestry, surveying, and other subjects were also taught. At the present time, with few exceptions, applied science and technology generally have gone to the technical universities and institutions of similar rank and to the technical schools. Only comparatively few departments survive, such as forestry, veterinary and agricultural science, which are still taught partly at the older universities, but principally at independent institutions. A very large amount of chemistry, principally pure chemistry, is taught at all German universities. It forms the great exception to the rule, and was taught so far back as the beginning of the seventeenth century. Different countries have, of course, followed different lines of procedure in the development of their higher technical instruction.

The German technical universities are not, strictly speaking, new creations. They have been developed—with one exception—from technical schools, trade schools, &c., founded in the first quarter of the nineteenth century. One of the great reasons for the foundation of these schools was to render Germany independent of the English manufactures and machinery, which, together with English capital and engineers, overran Germany in the first half of the nineteenth century.

The present organisation of English polytechnics represents a stage of development which German technical education passed through about forty years ago, and out of which nine of the ten technical universities have arisen.

There is little doubt that the rapid development of the German technical universities is owing, to a great extent, to their independent position towards the older universities. They do not enter into competition with them, but supplement them by providing a new type of instruction which the older universities, by reason of their environment, traditions, and organisation into the four faculties of law, medicine, theology, and philosophy, cannot give. The same is true of the semi-classical (Realgymnasia) and modern secondary schools (Oberrealschulen). Instead of attempting to graft a large amount of science, modern languages, mathematics, and drawing upon the older classical gymnasia, new secondary schools were created with the same length of courses, but of a semi-classical or completely modern type. All three types remained independent, and have consequently flourished, although the State still favours the classical gymnasia in State appointments and the liberal professions. As the technical universities developed so did the new types of secondary schools from which they receive so many of their students. Coordination between the older and the technical universities has been effected in a simple manner by making the leaving certificate of the secondary schools (the "Maturitas") the standard of matriculation for both types of university, and by putting university and technical university terms on the same footing as regards the length of study for the final examination.

The Emperor William has greatly influenced the rise of the technical universities by his consistent efforts to raise the status of the three (now four) situated in Prussia. He began by suggesting reforms in the secondary-school system, then called the principals of the technical universities into the Prussian Upper House, and finally conferred on the Prussian technical universities the power of granting the degree of Doctor of Engineering. The rest of the Empire followed his example, and thus the ten technical universities have been finally placed upon exactly the same footing as the older universities.

One reason why technical-school students in Germany possess a better educational equipment for their work than in England is owing to the fact that the lower divisions of the secondary schools are filled by students who wish to obtain the one-year military certificate which requires six years' attendance at a secondary school. The high proportion of fully qualified students at the technical universities is due to the fact that no examinations can be passed or higher State or municipal positions obtained without proof of the completion of a nine years' secondary-school course. Another reason why so many students attend the secondary schools and various universities in Germany is due to the lowness of the fees and the cheapness of living. To these reasons may be added the general German tendency to obtain as high a standard of schooling as possible before entering life.

Young men in Germany subject themselves to a laborious general and technical training, amounting after the preparatory school to from ten to fifteen or sixteen years, because the majority of those who complete their studies are generally sure of finding positions. The State and municipalities require large numbers for their various technical services. This partly explains the interest of the State in the quality of the instruction and the uniformity of the organisation of the technical universities. Most manufacturers give the preference to students with diplomas or degrees from the universities or technical schools. This is a result of the intimate advisory relations between manufacturers and the technical universities. Students are also sure of finding positions in the surrounding foreign countries, where large numbers of German "techniker" are to be found in all branches of industry. A further incentive to a longer course of study is found in the fact that, owing to the system of marriage dowries in Germany, young men with a technical diploma or degree are able to marry as soon as they obtain a position, even with a very small initial salary.

German students receive very little direct pecuniary assistance. Scholarships on the liberal English scale are practically unknown. There are a few modest "stipendia," and very poor students, upon production of the necessary proof, are allowed to study free and refund the amount of their fees later when they are in a position to do so.

Higher education of all types in Germany has been promoted by two further factors. First, by decentralisation so far as the Empire is concerned, as the various States of which the German Confederation is composed act independently in educational matters, and are constantly competing with one another in the development of their educational resources. Secondly, by the fact that almost all higher education is under direct State control, thereby rendering uniformity of organisation and coordination between institutions more easy.

Finally, it should be borne in mind that the German population exceeds the population of the United Kingdom by about eighteen or nineteen millions.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The Rev. E. A. Woodruffe-Peacock will deliver a lecture at the Botany School on Friday, February 18, at 5.0 p.m., on "A Special Method of Recording the Distribution of Plants." The lecture will be open to all interested in the subject.

Prof. W. Bateson, the Hon. N. C. Rothschild, and Mr. H. Scott, Inceptor in Arts, have been nominated to represent the University at the International Congress of Entomology to be held at Brussels in August, 1910.

Sir J. Larmor has been nominated a member of the board of electors to the professorship of chemistry, Sir Robert Ball to that of the Plumian professorship of astronomy, and Dr. Glaisher a member of the same board; Prof. A. Robinson and Prof. A. Keith have been nominated members of the board of electors to the professorship of anatomy, Dr. Darwin to that of the professorship of botany, Prof. W. W. Watts to that of the Woodwardian professorship of geology, Mr. A. Hutchinson to the same board, Prof. H. B. Dixon to that of the Jacksonian professorship of natural and experimental philosophy, Prof. A. R. Cushny to that of the Downing professorship of medicine, Dr. Hugo Müller to that of the professorship of mineralogy, Dr. R. T. Glazebrook to that of the Cavendish professorship of experimental physics, Dr. W. N. Shaw to that of the professorship of mechanism and applied mechanics, Prof. F. Gotch to that of the professorship of physiology, Sir W. W. Cheyne, Bart., and Mr. C. T. Dent to that of the professorship of surgery, Prof. J. Lorrain Smith to that of the professorship of pathology, and Mr. E. Gardner, M.P., to that of the professorship of agriculture.

London.—In memory of the late Dr. Ludwig Mond's scientific eminence and his generous benefaction of 3000*l.* towards the building of the Institute of Physiology at University College, the college committee has resolved to name the biochemistry research department of the institute "The Ludwig Mond Biochemistry Research Laboratory." The committee will shortly proceed to elect a Crewdson-Benington research student. The studentship, of the value of 50*l.*, tenable for one year in the biometric research laboratory of the college, is for the promotion of research in anthropometry and craniology in relation to evolution. Candidates should send their applications, together with any statement of qualifications that they desire to submit, not later than March 1 to the secretary of University College, Gower Street, W.C., who will furnish particulars of the studentship.

The degree of D.Sc. has been granted to Mr. W. B. Tuck, an internal student, of University College, for a thesis entitled "The Constitution of Hydroxyazo-compounds," and other contributions.

A scheme for the constitution of a board of the faculty of medicine has been approved.

Syllabuses have been approved in geology for intermediate and final pass B.A. examinations for external students. Practical work is provided for in both syllabuses; that for the intermediate examination includes the interpretation of weather charts, and at the final examination candidates must give evidence of adequate instruction in the field.

Prof. A. W. Crossley, F.R.S., has been elected dean of the faculty of science in succession to Prof. J. M. Thomson, F.R.S., resigned.

Dr. E. C. Seaton and Mr. W. H. Maxwell have been appointed Chadwick lecturers in hygiene and municipal engineering for the current session.

Convocation has approved the proposals for the establishment of a University of London Club.

At the South-western Polytechnic Institute, Chelsea, on March 11, Sir William H. White, K.C.B., F.R.S., will present prizes and certificates to students of the evening classes and day college.

The twelfth annual dinner of the Central Technical College Old Students' Association was held on Saturday, February 12, at the Trocadero Restaurant, Mr. H. A. Humphrey being in the chair. Among the guests of the evening were Sir Philip Magnus, M.P., who, in proposing the toast of the association, mentioned the great progress the Central Technical College has made and the invaluable training received there. Prof. W. J. Pope, F.R.S., was elected president for 1910.

An interesting address to the junior members of the architect's profession was given on January 31 by Mr. Ernest George, president of the Royal Institute of British Architects, and has been printed in the *Builder* for February 5. Mr. George offered much valuable advice to the student; earnest application is necessary, and a thorough education in science and art, as well as in wider fields of knowledge. There will be no time for idling; an architect must recognise that he is a man of business, with grave responsibilities to his client, and must cultivate methodical habits and exactness. The art of public speaking should be part of the architect's equipment; he may thus often contribute profitably to discussions.

The scheme for a London pageant which was before the public some time ago is now merged into a larger scheme of a Festival of Empire, to be held at the Crystal Palace this summer in the months of May, June, and July. The London pageant will form part of the scheme of the festival of empire. The council of the festival has invited the cooperation of the University Extension Board of the University of London in arranging courses of lectures preparatory to the pageant. The Board has accordingly arranged a course, to be given by Mr. Kenneth H. Vickers, on the history of London, arranged specially in view of the pageant of London to be held at the Crystal Palace as a part of the festival of empire. This course will be given in the London Day Training College on Thursday evenings at 8 o'clock, beginning February 17, when Sir R. Melvill Beachcroft, chairman of the London County Council, will take the chair. It is hoped that further courses of this kind will be arranged in different parts of London later in the year.

Of recent years the system of furthering scientific research most in vogue has consisted in the foundation of studentships or fellowships tenable at some university, for which recently graduated students of that or other universities are eligible. While this movement has undoubtedly led to the performance of a large amount of research in experimental science, and has, in this respect, been an unqualified success, it is a matter of common experience that the holders of these endowments have not, as a rule, reached a sufficiently mature age or acquired sufficient experience to initiate and develop original work in pure science. Indeed, it is not uncommon to find a successful research student baffled by a comparatively simple problem in mathematical analysis. In an article on "An Empire University" in the *Standard* for February 7, Dr. Waller, F.R.S., proposes a scheme which would obviate this difficulty. He suggests a class of appointment the holder of which should devote half his time to, and receive half his stipend from, teaching, the other half of his time being given to research, for which the corresponding remuneration should take the form of a fellowship. It is pointed out that this combination of teaching and research could not fail to have a beneficial effect in infusing an element of originality and individuality into the teaching. Dr. Waller's proposal might further have the advantage of improving the position of the existing underpaid assistant lecturers in our university colleges. Many of these at the present time turn out really excellent original work in addition to teaching, in return for a stipend which compares unfavourably with the awards made to research students for advanced study alone. There certainly appears to be a loss of efficiency in the existing system.

The annual meeting of the Association of Technical Institutions was held at the Skinners' Hall, London, on February 11 and 12. Dr. R. T. Glazebrook, F.R.S., president of the association, delivered his address, and dealt with the questions, What should be the aims of those teachers whose work lies mainly in the technical institutions of the country, and what should be their position in the scheme of education which is being gradually evolved? He pointed out that in Germany the great technical institutions have developed almost independently of the old universities, and asked, Are we to look forward to the growth of technical universities in each town arising naturally out of the technical colleges, but independent of and at the same time rivals of the existing universities? The answer Dr. Glazebrook thinks should be in the negative, with possibly one or two exceptions. It would be suicidal to suggest that in Manchester, Birmingham, Leeds, or Liverpool there should be two degree-giving bodies, one concerned with arts and pure science and the other with applied science. Modern universities, he said, will do for us what technical high schools have done for Germany. Speaking of London, Dr. Glazebrook said we may take it that the Imperial College of Science and Technology will in time become the technical university of London, whether as a part of London University or as a new university. On the second day of the meeting a general discussion took place upon the examination of evening students by the Board of Education, the City and Guilds Institute, the Royal Society of Arts, and the London Chamber of Commerce. Speaking on behalf of the Board of Education, Mr. C. A. Buckmaster said the Board is at present considering the whole subject of examinations, and will be glad to receive any information which the association can put before it. It realises the immense difficulties connected with the long period of the examinations, and will be prepared to do what it can to diminish the inconvenience. With regard to the Whitworth examinations, the Board of Education has to administer the will of Sir Joseph Whitworth, and though slight modifications of the scheme are possible, it would require an Act of Parliament to enable the Board to put it wholly into the melting-pot so that it may come out in a different form. After further discussion, a resolution was passed instructing the council to consider the subject of examinations in all its bearings.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 10.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. C. **Chree**: Some phenomena of magnetic disturbances at Kew. A recent paper ("Phil. Trans.," A, vol. ccviii., p. 205) discussed the diurnal inequality of Kew magnetic declination derived from 209 of the most highly disturbed days of the eleven years 1890 to 1900. The present paper discusses the corresponding phenomena for the same days in the other magnetic elements. It is shown that the irregular changes which form the most obvious feature of magnetic storms are accompanied by large *regular* diurnal changes, which are specially striking in the vertical force. In this element the disturbed days referred to above gave a regular diurnal inequality, the range of which in the average month of the year was about four times that given by the Astronomer Royal's "quiet" days. The influence of the hour of the day on the character of the disturbance is visible even on casual inspection of the vertical force curves. When disturbances lasting only a few hours occur in the late afternoon, there is almost invariably a rise in the force, whereas when they occur in the early morning there is a fall. Besides dealing with the analysis of the diurnal inequalities derived from the disturbed day curves, the paper discusses some new phenomena observed in the a-periodic changes of the magnetic elements.—R. B. **Sangster**: A novel phenomenon in the diurnal inequality of terrestrial magnetism at certain stations. The mean diurnal inequality at Greenwich for epoch 1900–6, at Falmouth, 1903–7, and at Pawlowsk (Russia), 1873–85, is dealt with so as to exhibit the inequality in the plane of the astronomical meridian. It is then shown that the component of the force parallel to the earth's axis has little, or no, variation during the hours from noon to about 5 p.m. There is, however, considerable simultaneous variation in the declination and in the horizontal and vertical forces. The winter months invariably showed a shorter duration of the feature, and, generally, a larger diurnal range produced a more exact and lengthened exhibition of the phenomenon. The phenomenon was found to exist whether "quiet" days or "all" days were dealt with, and, while long periods naturally furnished smoother curves, the feature was also prominent in cases where the mean of only five "quiet" days in a single month was employed.—Prof. P. V. **Bevan**: The absorption spectra of vapours of the alkali metals. The paper gives an account of the absorption spectra of vapours of the metals potassium, rubidium, and cæsium. Prof. R. W. Wood has shown that the absorption spectrum of sodium vapour has for its most striking feature the lines of the principal series. The same series lines for the metals of this communication appear in the absorption spectra. The author has measured the wave-lengths of these lines so that now 24 potassium lines, 25 rubidium lines, and 19 cæsium lines are known of the principal series. Of these, 15 are new in the case of potassium, 21 in the case of rubidium, and 12 in the case of cæsium. In the cases of rubidium and cæsium, the metals themselves were not available, but by heating the chlorides with sodium or potassium, enough vapour was obtained to show the absorption spectrum quite definitely. These lines, with the lines measured by Wood for sodium, give good data for testing various formulæ that have been suggested for representing the series lines. None of the suggested formulæ tested give values representing the series within the limits of experimental error. In particular, the quantity of Rydberg's formula N_0, or of the modified Rydberg formula of Ritz, is shown not to be constant. One of the most interesting facts arising out of the investigation is that none of the lines of the associated series appear in these absorption spectra. Channeled space spectra appear which are analogous to the similar spectra for sodium vapour. Further interesting facts noted are in regard to the effect of mixtures of vapours. Some lines or bands appear in spectra of mixtures which are apparently unconnected with the spectra of either constituent. This was specially evident in the case of cæsium and sodium; a set of bands appeared at about W.L. 3000–3500 which do not appear in the sodium spectrum, nor in the mixture of potassium and cæsium spectrum. Other interesting phenomena appear as the density of the vapour is increased in the widening of the lines and the appearance of satellites connected with the lines of the series. The vapour of lithium has not yet been successfully investigated, as it attacks the material of all tubes hitherto tried.—Prof. C. H. **Lees**: The shapes of the isogeotherms under mountain ranges in radio-active districts. The author shows that for mountain ranges of many different forms of section, the shapes of the isogeotherms may be accurately determined in cases in which the heat conductivity and radio-activity of the materials of the range may be taken as constants. Curves showing the isogeotherms in three typical cases are given, and it is shown that some of the statements generally made with respect to them are not correct.—F. B. **Pidduck**: The propagation of a disturbance in a fluid under gravity. The paper relates to the determination of the motion set up in a heavy incompressible fluid of uniform depth by a limited initial disturbance; the generally accepted solution in terms of a definite integral represents the disturbance as being propagated instantaneously, although the velocities of the simple harmonic wave-trains of which the solution is built up are all finite. In the paper this solution is transformed into a series-solution analogous to that given by Cauchy and Poisson for infinite depth. In the more general problem of one-dimensional motions in dispersive media the integral solution may represent the disturbance as either being limited at any time by an advancing wave-front, or as being propagated instantaneously. A method, based on the examination of the convergence of the definite integral, is given for deciding between these conditions. An investigation is given of the propagation of waves over a slightly compressible heavy fluid. Solutions of the Cauchy-Poisson type give motions which such a fluid can execute; but these are not due to limited initial disturbances, as they imply a diffused initial condensation. The corresponding result for incompressible fluids is that solutions of the type in question imply a diffused unequilibrated distribution of pressure on release from the initial state.—Dr. A. H. **Gibson**: The flow of water through pipes and passages having converging or diverging boundaries. A series of twenty-five pipes, all having the same initial and final area, but having different angles of convergence or divergence, were examined. Some of these pipes were circular in section; others square; others rectangular. The following are the main conclusions:—(*a*) In a circular pipe with uniformly diverging boundaries, the total loss of head attains its minimum value with an angle of divergence θ of about 5° 30′. Owing to the comparatively large effect of friction in a pipe having a small value of θ, the value giving the minimum loss of head will be somewhat less in pipes larger than those examined, which had a larger diameter of 3 inches and a smaller diameter of 1·5 inches. (In large pipes of the type used in the Venturi meter, experiment shows that this value is about 5° 6′.) As θ is increased the loss of head, expressed as a percentage of $(v_1-v_2)^2/2g$, increases very rapidly from its minimum value of about 13·5 per cent. to a maximum of about 121 per cent. when $\theta=63°$, afterwards diminishing to about 102 per cent. as θ is increased up to 180° (a sudden enlargement of section). (*b*) The effect of making the pipe trumpet-shaped so as to give a rate of change of velocity uniform per unit length of the pipe may in some cases be to increase, in other cases to reduce, the loss of head. In the only case tried in the circular pipes the loss in the trumpet-shaped pipe was 23·5 per cent., as against 17·3 per cent. in a straight taper pipe of the same length, and having θ equal to 10°. In the case of a rectangular pipe, however, boundaries curved to give respectively uniform retardation in time and length ($dv/dt=$ const.) and ($dv/dx=$const.), showed that the loss, as compared with that in the corresponding straight-taper pipe ($\theta=20°$), was reduced respectively by 5·3 per cent. and 12·1 per cent. Further experiments are desirable to determine precisely the form of curve giving least loss of head. (*c*) The loss of head in a pipe of square section is greater—at the least 20 per cent. greater—than in a circular diverging pipe of the same length and same initial and final area, while the minimum loss is obtained when the angle between opposite faces of the pipe is approximately 4°. (*d*) A change in the shape, as opposed to the area, of the cross-section of a pipe leads to considerable loss of head. Thus, by changing the section of a pipe from that of a square of 2·66 inches side to a rectangle 1·33 inches by 5·32 inches in a length of 9·94 inches, a loss of head equal to 0·484 $v^2/2g$ was experienced. (*e*) Where a rectangular pipe has one pair of sides parallel and the second pair uniformly diverging, the loss of head is much greater than in a circular pipe having the same length and the same initial and final areas. The minimum loss is obtained with θ about 11°. (*f*) The critical velocity of flow in a circular pipe with uniformly converging boundaries is much greater than in a parallel pipe of the same mean diameter. The critical velocity increases rapidly with the angle of convergence, its lower value, at 57·5° F. in the experimental pipes (from 3 inches to 1·5 inches diameter), being as follows at the point where the diameter is $2\frac{1}{4}$ inches:—

θ	5°	7½°	10°	15
C.V. (ft. per second)	2·7 ...	3·4 ...	4·3 ...	5·7

The lower critical velocity in a parallel pipe of the same mean diameter is 0·13 foot per second at this temperature.—R. **Rossi**: The effect of pressure upon arc spectra:—Titanium. The work is on the range from λ4000 to λ4600, examined with the $21\frac{1}{2}$ ft. concave grating spectrograph of the Manchester University Physical Laboratory, which gives on the photographic plate a dispersion of 1·3 Ångström units per millimetre. The arc was formed between a carbon pole and a graphite tube filled with titanium carbide. The pressures at which the photographs were taken were 15, 30, 50, and 100 atmospheres. The broadening, reversal, displacement, and changes of relative intensity of fifty-two lines were studied. All lines were found to broaden out with an increase of pressure, the amount and type of broadening being different for different lines. Several lines were found to reverse under pressure, some symmetrically and some asymmetrically. All lines were found to be displaced towards the red end of the spectrum, the displacement being a linear function of the pressure within the limits of accuracy of experiment. The value of the displacement varies for different lines, and the unreversed lines cannot be grouped into sets giving the same displacement. The reversed lines, however, with the exception of one, can be formed into two groups, their mean displacements being very nearly in the ratio 3 : 5. The mean displacement per atmosphere of all the titanium lines studied is found to be 0·003652 Ångström unit. The limited number of lines studied, both in this work and by other workers on the Zeeman effect, do not enable one to obtain any relation between the pressure displacement and magnetic separation. The relative intensity in nearly all lines is altered by pressure, and a list is given of the lines which are thus enhanced or weakened.—Sir James **Dewar** and Dr. H. O. **Jones**: The change of carbon disulphide into a gaseous product condensable and explosive near the temperature of liquid air.

Physical Society, January 21.—Dr. C. Chree, F.R.S., president, in the chair.—R. E. **Baynes**: Saturation specific heats, &c., with van der Waals's and Clausius's characteristics. By use of a special variable, exact expressions may be found with van der Waals's characteristic for the specific heats **s**, **s**′ of saturated liquid and vapour and for all other magnitudes connected with the state of saturation, and if $\mathbf{k}$ denotes the isometric specific heat, which is constant or a function of the temperature only, (i) $\mathbf{s}-\mathbf{k}$ is always positive, increasing from R to ∞ as the reduced temperature τ rises from 0 to 1; (ii) $\mathbf{k}-\mathbf{s}'$ is always positive, having a minimum value 4·96 R when $\tau=0{\cdot}72$, and being ∞ when τ is either 0 or 1; (iii) inversion in the sign of $\mathbf{s}'$ can thus occur when $\mathbf{k}/R>4{\cdot}96$ or $\kappa=1+R/\mathbf{k}<1{\cdot}202$, so that, on the assumption that $\mathbf{k}/R=N+\frac{1}{2}$ for an N-atomic gas, inversion can occur only if the gas has at least *five* atoms in its molecule; (iv) the latent heat of vaporisation increases continuously from 0 to its largest value (27/8)RT as τ falls from 1 to 0, T being the absolute critical temperature; (v) the work of vaporisation has a maximum value 0·55 RT when $\tau=0{\cdot}70$. Clausius's characteristic similarly treated gives widely different results:—(i) while $\mathbf{s}-\mathbf{k}$ is always positive, it is ∞ when τ is either 0 or 1, having a minimum value 15·3 R for $\tau=0{\cdot}83$; (ii) $\mathbf{k}-\mathbf{s}'$ is always positive, is ∞ when τ is either 0 or 1, and has a minimum value 11·36 R for $\tau=0{\cdot}81$; (iii) inversion in the sign of $\mathbf{s}'$ can thus only occur if $\mathbf{k}/R>11{\cdot}36$ or $\kappa<1{\cdot}088$, or, on the above assumption, if there are at least *eleven* atoms in the molecule; (iv) the latent heat of vaporisation increases continuously from 0 to ∞ as τ falls from 1 to 0; (v) the work of vaporisation has a maximum value 0·69 RT when $\tau=0{\cdot}77$. The contrast between these results is especially marked for $\mathbf{s}-\mathbf{k}$ and the latent heat.—Prof. **Thornton**: The polarisation of dielectrics in a steady field of force. Experiments on the polarisation of dielectric ellipsoids and cylinders suspended in a steady electric field. From measurements of the field-intensity, the dimensions of the ellipsoids, and the frequency of torsional swings with and without the field, the dielectric constant can be found from time to time. The longitudinal component of polarisation reached a higher value than previously recorded, and was found to be independent of the intensity of the field inside the ellipsoid and to be quasi-elastic in type. Quartz, fused and crystalline, flint-glass, amber, sulphur, ebonite, rubber, gutta-percha, paraffin-wax, resin, and sealing-wax were examined. From the rate of increase of the dielectric constant the specific resistance of these was found by considering the change of polarisation to be equivalent to a current. The rate of depolarisation when the field was reversed was the same as that of polarisation, and uniform for several hours. The cause of this and for the independence of the field-intensity may be looked for in the continued separation of molecular charge by the attraction of the opposite charges on adjacent molecules induced by the application of the field. From a comparison of these results and those in alternating fields, the variation of the dielectric constants with frequency can be anticipated.—A. **Campbell**: The use of mutual inductometers. In the use of mutual inductometers, the use of a balancing coil in one arm of the bridge causes considerable loss of sensitivity. With an equal-arm bridge this difficulty is overcome by putting the halves of the secondary circuit in adjacent arms of the bridge. The auxiliary balancing coil is dispensed with, and the usual formula is applicable. The measurement of effective resistance, which is, in general, more troublesome than that of self-inductance, was discussed. The effective resistance determines the total power spent by an alternating current in a conductor, and is important in telephonic and other high-frequency work. When measured by a self-inductance bridge, large errors may be introduced by the small residual inductances of the ratio arms. The analogous formulas for mutual inductance bridges, which indicate that the inductances of the ratio arms must be accurately proportional to their resistances if errors are to be avoided, are here worked out. A null method in iron testing analogous to Max Wien's self-inductance method is described. The ring to be tested is wound with primary and secondary coils. The magnetising current, I_1, is passed through the primary coil, the primary circuit of a mutual inductometer, and a slide-wire resistance. The detecting instrument is put across a circuit consisting of the secondaries of the ring and the inductometer in opposition, and a part, Q, of the slide-wire resistance. By adjusting Q and the reading M of the inductometer a balance is obtained, in which case the power lost in the ring is equal to $QI_1^2\times N_1/N_2$, where N_1 and N_2 are the numbers of turns in the windings of the ring. The method is applicable to the testing of current transformers.

Mineralogical Society, January 25.—Prof. W. J. Lewis, F.R.S., president, in the chair.—Dr. S. J. **Shand**: A group of minerals formed by the combustion of pyritous shales in Midlothian. At the Emily coal-pit, Arniston, as the result of the slow combustion of a heap of shaly refuse, which became spontaneously ignited, presumably owing to the evolution of heat caused by the atmospheric oxidation of pyrites, a number of uncommon mineral species have been formed, of which five have been recognised, viz. native sulphur, sal-ammoniac, tschermigite, mascagnite, and a possibly new species, aluminium sulphate.—Prof. W. J. **Lewis**: A crystal-holder for measuring large specimens. For this purpose a clamp of convenient form and with various adjustments has been designed and made by Mr. Pye.—T. **Crook**: Some observations on pleochroism. The phenomena of pleochroism displayed by plates of coloured minerals when examined in ordinary light were treated in a general way for both parallel and convergent rays, and the factors upon which they depend were discussed.—L. J. **Spencer**: Notes on the weight of the "Cullinan" diamond, and on the value of the carat-weight. Varying statements of the weight of the "Cullinan" diamond, in its original, uncut form have been published, but from a comparison of the carat-weights against which it was weighed in 1905 it is concluded that the correct weight was 621·2 grams, or $3025\frac{3}{4}$ English carats of 205·304 milligrams (as defined by the Standards Department of the Board of Trade in 1889). Other values are, however, given for the English carat and for the carat in other countries, and the average value has decreased, on the whole, in course of time. The carat-weight had its origin in the use as weights of seeds of *Ceratonia siliqua*, which weigh approximately a carat. The existing confusion would be obviated by the general adoption of the metric carat of 200 milligrams (one-fifth of a gram) recently recommended by the International Committee of Weights and Measures (NATURE, 1908, vol. lxxii., p. 611).—Dr. G. T. **Prior**: A basalt from Rathjordan, Co. Limerick. Specimens of basalt from Rathjordan in the Allport collection in the British Museum show in thin slices under the microscope round sections of isotropic material containing central and marginal inclusions, and thus resembling small leucites. The rock is very similar, mineralogically and chemically, to leucite-basalts from Bohemia, but contains only a small fractional percentage of potash. This fact, combined with observations of the refractive indices, leads to the conclusion that the isotropic material is mainly analcite, and not leucite.—Dr. G. F. H. **Smith** and Dr. G. T. **Prior**: A fluo-arsenate from the Indian manganese deposits. A crystallographical and chemical examination made of the green arsenate from Kajlidongri, Jhábua State, mentioned in Mr. Fermor's monograph on the manganese-ore deposits of India (Rec. Geol. Surv. India, 1908), led to the following results:—composition, $(MgF)CaAsO_4$; specific gravity, 3·768; hardness, $3\frac{1}{2}$; colour, apple- to brownish-green; monoclinic, $a:b:c=0{\cdot}7485:1:0{\cdot}8453$, $\beta=120°\ 50'$; forms present, (010), (110), (111), $(\bar{1}31)$, (311), $(\bar{1}12)$, $(\bar{1}52)$; good cleavage parallel to $(\bar{1}01)$, and partings parallel to (110), $(\bar{1}02)$, (331); twin plane, (100); refractive indices, 1·640, 1·660, 1·666; acute bisectrix nearly perpendicular to $(\bar{1}01)$, and axial plane at right angles to the plane of symmetry, but no horizontal dispersion was noticed; $2E=105°$ approximately, with negative birefringence. The material is probably identical with tilasite, which was first described by Sjögren in 1905 from the manganese deposits of Långban, Sweden.—H. E. **Clarke** and Prof. H. L. **Bowman**: The composition of a stone from the meteoric shower which fell at Dokáchi, Bengal, on October 22, 1903. The small crusted stone examined, weighing 17·8 grams, shows chondritic structure, and belongs to the class Ci of Tschermak. The chief constituent minerals are bronzite (37·9 per cent.), olivine (37·7 per cent.), nickel-iron (18·5 per cent.), troilite (4·1 per cent.).—Dr. G. F. H. **Smith** exhibited cut and rough specimens of synthetical sapphire recently produced by Prof. Verneuil, oxides of iron and titanium being the colouring agents.

Geological Society, January 26.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Dr. A. S. **Woodward**: A skull of Megalosaurus from the Great Oolite of Minchinhampton. The specimen was discovered and prepared by Mr. F. Lewis Bradley, and shows, for the first time, the skull of Megalosaurus. It agrees closely with the megaloaurian skulls of other genera already discovered in the sic and Cretaceous of North America, and resembles atosaurus in possessing a bony horn-core on the nose. As in the jaws of Megalosaurus previously known, the premaxilla of the new specimen bears four teeth; but these teeth are so different from those of the typical *M. bucklandi* of the same horizon that they prove the Minchinhampton fossil to belong to a distinct species.—A. M. **Finlayson**: Problems of ore-deposition in the lead and zinc veins of Great Britain. Chemical analyses show traces of lead and zinc in several of the rock-formations of Britain, but the ores of the veins are concluded to be derived, not from the country-rock, but from deeper sources, probably in the first place by magmatic segregation. They were transported in the deeper zones by "juvenile" waters, in which fluorine was an important constituent, while in the upper zones, especially in limestone districts, underground waters of meteoric origin have played a large part. The vein-solutions carried (1) alkaline sulphides, which held the sulphides of the metals in solution, and (2) alkaline and earthy carbonates. The presence of the latter is indicated by the alteration of the wall-rock, which shows a concentration of potash, lime, and carbon dioxide, and a leaching of soda, magnesia, oxides of iron, and silica. In limestones, however, the chief effects of solution on wall-rock were concentration of silica and magnesia. Ore-deposition has persisted over a vertical range of 5000 to 6000 feet, of which more than one-half has been shorn off by denudation. The effects of secondary processes have been exerted to depths of more than 600 feet.—J. W. **Jackson**: The vertebrate fauna found in the cave-earth at Dog Holes, Warton Crag (Lancashire). The remains described in this communication were obtained during the systematic investigation by the author of a cave on Warton Crag (west Lancashire) in 1909. The cave, known as Dog Holes, is situated on the western side of Warton Crag, and opens on a sloping "pavement" of limestone. It owes its origin to the erosion of a series of master-joints in the Carboniferous Limestone. The specimens were derived from the cave-earth below the surface-soil in one of the chambers of the cave. They comprise a large series of small vertebrates, including rodents, Insectivores, amphibians, birds, &c. Among the rodents are some interesting forms, the chief of which are the Arctic and Norwegian lemmings and the northern vole. A large series of non-marine Mollusca was found along with these remains, one species being of particular interest, namely, *Pyramidula ruderata*, only known in this country by its fossil remains in Pleistocene deposits. The Pleistocene age of the remains is fully discussed, as well as their possible mode of origin through a former swallow-hole. In many respects the cave and its contents bear a striking resemblance to the famous Ightham fissures.

Zoological Society, February 1.—Prof. E. A. Minchin, vice-president, in the chair.—The Hon. P. A. **Methuen**: A collection of fresh-water Crustacea from the Transvaal. An account of some Entomostraca collected from Lake Chrissie and other pans or lakes in the Carolina district, which is high veldt country lying near the borders of Swaziland. The paper also gave a short description of the "lie" of the lake, and notes on the geology of the district and the composition of the water.—Dr. J. **Pearson**: Holothurioidea from the Kerimba Archipelago, Portuguese East Africa, and from the Mergui Archipelago, Lower Burma. The collection from the Kerimba Archipelago contained twenty-one species, all of which had been previously described. In this paper it is proposed to establish a new genus for the inclusion of *Colochirus violaceus*, Théel. The collection from the Mergui Archipelago called for no special comment, none of the fourteen species being new.—Dr. G. S. **Brady**: A revision of the British species of Ostracoda belonging to the subfamilies Candoninæ and Herpetocyphridinæ. The paper was a synopsis intended to show our present knowledge of the families referred to, describing briefly the known British species. Some few new genera and species, and others already described by foreign authors but not previously recognised as British, were dealt with.—F. E. **Beddard**: The anatomy of *Hippopotamus amphibius*.

Royal Anthropological Institute, February 8.—Mr. J. Gray, treasurer, in the chair.—A. L. **Lewis**: Some dolmens of peculiar types in France and elsewhere. The author described several *allées couvertes* in the department of the Oise, in France, which have at one end an open portico or shrine with a round hole 18 inches in diameter opening into the *allée*. He then sought to find the monuments most nearly resembling them, which appeared to be some of those in the provinces of Bohuslan and Vestergothland, in Sweden, described by Dr. Oscar Montelius. The "Giants' Graves" in Sardinia, recorded ninety years ago by Count de la Marmora, and quite recently by Dr. Duncan Mackenzie, had some points in common with them, but they also had quite special features of their own, and it did not appear to the author that there was any real connection between the dolmens of the Oise and those of Sweden or Sardinia, as several other kinds of dolmens seemed to bar the way between them. His general conclusion was that the building of dolmens was not confined to one race and the building of circles to another, nor that there was any one race which originated or diffused both, but rather that megalithic construction was a phase of culture through which many races have passed and which was developed in different ways, not only by separate races, but also, in very restricted areas, by different tribes, without regard to any racial differences or connections between them.—Dr. J. S. **Holden**: The existence of a Palæolithic bed beneath the glacial Boulder-clay in south-west Suffolk. The implements were discovered in a well sinking at a depth of 100 feet in a seam of unrolled gravels beneath the blue Boulder-clay. The finding of these rude implements *in situ* beneath the glacial Boulder-clays is of considerable importance, as they are evidence of the existence of man on this old land surface probably long before the beginning of the Glacial period. In the discussion, although doubt was expressed as to the artificial character of the implements by some of the speakers, the general opinion was that they were of human workmanship.

Mathematical Society, February 10.—Sir W. D. Niven, president, in the chair.—H. W. **Richmond**: Note on double-sixes of lines.—Dr. H. F. **Baker**: Notes on the theory of functions. (1) On a certain logical principle; (2) on the establishment of the order of a doubly periodic function; (3) two queries.—Prof. H. **Lamb**: The diffraction of a solitary wave.

EDINBURGH.

Royal Society, January 10.—Dr. James Burgess, vice-president, in the chair.—E. M. **Wedderburn**: Current measurements in Loch Garry. The measurements were made with an Ekman current meter. The general conclusions drawn from the Loch Ness observations were confirmed. At the end of the lake the currents were not very uniform, but some very steady currents were observed at the centre. The return current was strongest just above the temperature discontinuity, and at the bottom indications were obtained of currents in the same direction as the wind. The currents were most uniform with moderate and steady winds. In stormy weather they were very variable, both in direction and in velocity.—John **McWhan**: Observations on some spark-gap phenomena. The paper described a number of curious effects produced by and on sheets of dielectrics interposed in various ways in the path of the electric discharge in air. Many of these depended on the fact that the electrodes were not in the line of the spark. In some the dielectric was perforated, in others it was driven in a definite direction with or without rotation, as the case might be, and in other cases the accompanying luminous effects with the brush discharge were very remarkable. The phenomena could not be co-ordinated on any of the ordinarily accepted theories.—Dr. G. A. **Carse** and D. **MacOwan**: Earth-air electric current and atmospheric potential gradient near Edinburgh. The observations were made with Wilson's portable electrometer. The values of the earth-air current in the town were found to be about one-tenth of those got by

Mr. Wilson at Peebles; at the Blackford Hill, just outside the city on the south, the value was about three times as great as in the city, and at an intermediate station intermediate values were found.—Dr. J. S. **Thomson**: Alcyonaria from the Cape of Good Hope, part i. The paper contained a description of thirteen species obtained off the shore in depths varying from 10 to 70 fathoms. Six were new to science, and one new genus was recorded.—Prof. J. T. **Morrison**: Notes on proposed meteorological instruments. The one was a self-recording anemometer capable of giving at once the north-south and east-west components of the wind's velocity. This was to be accomplished by use of a sphere which, by means of appropriate gearing, was kept rotating at a rate proportional to the wind velocity, while its horizontal axis of rotation was so connected to the vane as to point along the direction of the wind. Two small discs, equidistant from and respectively north and east of the vertical line through the centre of the sphere and pressed against the lower surface, would then rotate with the sphere and thus record the two components. The other instrument was a modified air thermometer, which could be set by comparison with a contiguous Six's thermometer in such a way that the reading gave at once the barometric pressure. The instrument was portable, and was intended to take the place of the aneroid, one of the most untrustworthy of all instruments used by travellers.

January 24.—Prof. Ewart, vice-president, in the chair.—Dr. Williamina **Abel**: The development of the autonomic nervous mechanism in the alimentary canal of the bird. In the wall of the alimentary canal there are various nerve plexuses and ganglia arranged in two layers, the function of which is to control and regulate the movements of the intestine. Are these nerve structures developed *in situ* or are they outgrowths from the central nervous system? From the point of view of physiological experiment the balance of evidence is in favour of the first view, the work of Bayliss, Starling, Langley, Elliot and others pointing to the possession of peculiar properties which separate these intestinal plexuses off fundamentally from the nerve elements of the central nervous system. The evidence afforded by histological examination of the developing embryo is, however, for the most part in favour of the second view. His, senior, Onodi, and His, junior, all support the outgrowth theory as a result of investigations made by them on the relationship of the visceral nerve supply to the central nervous system. It seemed desirable to repeat the investigations with the use of the modification of the silver nitrate staining method introduced by Ramon y Cajal. The material used was embryonic chicks varying in age from two to seven days' incubation. The work was carried out in the physiological laboratory of Glasgow University, and led to the conclusion that the autonomic nerve mechanism in the alimentary canal is formed as an outgrowth from the central nervous system. This view, which receives the support of different histologists, would suggest that the peculiar properties to the autonomic nerve mechanism of the alimentary canal were secondary in development to that of the cells.—J. J. **Simpson**: A new species of Cactogorgia. This specimen, which differed in certain specific characters from other known forms of Alcyonaria, was one of the collection in the Royal Scottish Museum. Unfortunately, there was no label of any kind or mention of the locality where it had been found.—Dr. J. **Oliver**: The stimulatory action of the oosperm in the uterus.—Dr. J. **Brownlee**: The significance of the correlation coefficients applied to Mendelian distributions. This paper gave an account of the manner in which the values of the correlation coefficient varied according to the method of calculation when populations of parent and offspring obtained on the Mendelian hypothesis were examined, and it was shown that in cases of dominance the four-fold division method gave higher correlation values than the product method. The effect of different forms of assortive mating on the correlation coefficient was also shown, and from one form of assortive mating a series of hereditary correlation coefficients were obtained identical with those found from observation. The effect of selective mating was considered, and the forms of selective mating which raised were distinguished from those which lowered the correlation coefficient. The correlation coefficient from parent to offspring when three races mix instead of two was also investigated, and the values of the coefficient in this case found to be considerably higher. Fraternal correlation was found to be considerably increased by assortive mating, and in certain cases by selective mating, while in the case of a mixture of more than two races further increase took place. These theoretical deductions were illustrated by cases of inheritance of colour in animals.

PARIS.

Academy of Sciences, February 7.—M. Emile Picard in the chair.—D. **Gernez**: A means of restoring phosphorescent properties to the sulphides of the alkaline earths. A sulphide of strontium, which immediately after its preparation phosphoresced brilliantly, slowly lost this property on exposure to air, but regained its phosphorescence on heating to redness in a current of hydrogen. This regeneration of the phosphorescence also takes place with barium sulphide.—M. van der Waals was elected a foreign associate.—M. **Luizet** and J. **Guillaume**: Observations of the Innes comet (1910*a*) made at the Observatory of Lyons. Results for January 26, 29, 30, and 31.—MM. **Javelle, Charlois,** and **Schaumasse**: The comet 1910*a*. Observations made at Nice. Data given for January 25, 26, 27, February 1, 2, 3. The comet has a round, well-defined nucleus 10″ in diameter.—M. **Borrelly**: Observations of the comet 1910*a* made at the Observatory of Marseilles with the comet finder of 16 cm. aperture. Data given for January 25, 26, 27, 29, 30, and February 1 and 3.—M. **Coggia**: Observations of the comet 1910*a* made at the Observatory of Marseilles with the Eichens equatorial of 26 cm. aperture. Results for January 25, 26, 29, 30, and February 1 and 3.—MM. **Claude, Ferrié,** and **Driencourt**: The comparison of chronometers or clocks at a distance by the method of coincidences by means of radio-telegraphic signals. Details are given of the mode of transmission of the signals. The method was tested between the observatories of Paris and Montsouris. The errors are less than 0·01 second. Further comparisons will be carried out between Paris and Brest as soon as the damage done to the apparatus at the Eiffel Tower by the floods has been repaired.—A. **Demoulin**: The K systems and congruences.—Johannes **Mollerup**: A remark on integral equations of the first species.—Nicolas **Kryloff**: Developments following hypergeometric polynomials.—Michel **Plancherel**: The representation of an arbitrary function by a definite integral.—Richard **Birkeland**: Some irregular integrals of linear differential equations.—A. **Étéve**: Autorotation. An explanation of an experiment due to M. Riaboutschinsky.—C. E. **Guye** and S. **Ratnovsky**: The variation of the inertia of the electron as a function of the velocity in the kathode rays and on the principle of relativity. The experimental results are compared in parallel columns with the figures calculated from the hypotheses of Lorentz and with those calculated from Abraham's formula. The deviations from the Lorentz are about 1 to 2 per cent., 16 being positive and 11 negative. The divergences from the Abraham formula amount to nearly 4 per cent., 26 being positive and 1 negative. Hence it is clear that the Lorentz formula alone is compatible with the experimental results.—G. A. **Hemsalech** and C. **de Watteville**: The high-temperature flame spectrum of iron. The temperature used was that of the oxyacetylene blow-pipe. The spectrum is very nearly the same as that obtained with the oxyhydrogen blow-pipe, except that the intensity of all the lines is so much increased that an exposure of ten minutes is sufficient to give the image of a well-developed spectrum.—M. **Guilleminot**: The radiochroism of organic bodies towards the α, β, and γ rays of radium and the X-rays.—Louis **Dunoyer**: The emission of electric charges by the alkaline metals. A repetition of an experiment due to J. J. Thomson on the emission of negative corpuscles by rubidium. The author thinks that the assumption of the spontaneous explosion of some atoms, analogous to the destruction of radio-active atoms, is not necessary for the explanation of the facts observed.—Louis **Nomblot**: The reduction of the nitroso derivatives of acetyl- and benzoylhydrazobenzene. Various attempts to produce triazane derivatives by the reduction of these compounds with hydrazine hydrate, aluminium amalgam, and zinc powder were unsuccessful.—A. **Trillat**: Disinfection by incomplete combustion.—F. **Bordas** and M. **Touplain**: Contribution to the study of the reactions due to the colloidal state of milk. The authors think that their results demonstrate the uselessness of assuming the intervention of anæroxydases, catalases, &c., to explain the phenomena of the decomposition of hydrogen peroxide in milk.—MM. **Maurain** and **Warcollier**: The action of the ultra-violet rays on wine in course of fermentation. It is shown that the sterilisation of white wine is easier than cider.—J. **Chevalier**: The influence of culture on the amount of alkaloids in some Solanaceæ. In the cultivation of belladonna the addition of phosphatic or potash manures did not cause any addition to the alkaloid percentage; the amount of the latter is considerably increased, however, by the use of nitrogenous manures, a mixture of nitrates and farmyard manure giving the best results.—M. **Hegyi**: Some observations on the black scab of the potato. This disease, which has caused great damage to the potato crops in Hungary and Germany, has been attributed to *Bacillus phytophthorus*, propagated by infected tubercles. The author's observations have led to the conclusion that the disease is not propagated by the tubercles, but is due to the bacteria of the soil penetrating through lesions into the interior of the stem.—M. **Doyon**: The formation in the liver of an anti-coagulating substance under the influence of an alkaloid.—A. **Rosenstiehl**: The consequences of Young's theory. Chromatic construction in space.—Louis **Roule**: Fishes of the family of Nemichthyides.—E. **Vasticar**: The structure of the tectoria.—H. **Vincent**: The experimental bases of anti-typhoid vaccination.—H. **Carré**: The etiology of intestinal congestion in the horse.—L. **Cayeux**: The limestone algæ of the Girvanella group, and the formation of ooliths.

DIARY OF SOCIETIES.

THURSDAY, February 17.

Royal Society, at 4.30.—Phosphorescence produced by α- and β-Rays: E. Marsden.—Theory of the Luminosity produced in Certain Substances by α-Rays: Prof. E. Rutherford, F.R.S.—(*a*) The Scattering of the α-Particles by Matter; (*b*) The Ionisation produced by an α-Particle. Part II.: Connection between Ionisation and Absorption: Dr. H. Geiger.—The Influence of Pressure on the Boiling Points of Metals: H. C. Greenwood.—On the Viscosities of the Gases of the Argon Group: A. O. Rankine.

Royal Institution, at 3.—Illumination, Natural and Artificial (Experimentally Illustrated): Prof. S. P Thompson, F.R.S.

Linnean Society, at 8.—The Plum-moths of the Seychelles Expedition: T. B. Fletcher, R.N.—Die von Herrn Hugh Scott, auf den Seychellen gesammelten Embiidinen, Coniopterygiden und Hemerobiideen: Dr. G. Enderlein.—Die Termiten der Seychellen-Region: Dr. Nils Hohngreen.—On the Land and Amphibious Decapoda of Aldabra: L. A. Borradaile.

Royal Society of Arts, at 4.30.—The Bombay Housing Question: G. O. W. Dunn

Institution of Mining and Metallurgy, at 8.

Royal Geographical Society, at 5.—Waves in Water, Sand, and Snow: Dr. Vaughan Cornish.

Royal Anthropological Institute, at 5.—Head Hunters in Assam: T. C. Hodson.

Institution of Electrical Engineers, at 8.—Electric Clocks: F. Hope-Jones.

FRIDAY, February 18.

Royal Institution, at 9.—Halley's Comet: Prof. H. H. Turner, F.R.S.

Institution of Mechanical Engineers, at 8.—Annual General Meeting.—*Further discussion*: Ninth Report to the Alloys Research Committee: On the Properties of some Alloys of Copper, Aluminium, and Manganese (with an Appendix on the Corrosion of Alloys of Copper and Aluminium when Exposed to the Sea): Dr. W. Rosenhain and F. C. A. H. Lantsberry.

Institution of Civil Engineers, at 8.—Irrigation Works: Sir R. Hanbury Brown, K.C.M.G.

SATURDAY, February 19.

Royal Institution, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

MONDAY, February 21.

Royal Geographical Society, at 8.30.—Explorations in and around Lake Chad: Captain J. Tilho.

Royal Society of Arts, at 8.—The Petrol Motor: Prof. W. Watson, F.R.S.

Victoria Institute, at 4.30.—Arianism in its Bearing on Modern Questions: Prof. H. M. Gwatkin.

TUESDAY, February 22.

Royal Institution, at 3.—The Emotions and their Expression: Prof. F. W. Mott, F.R.S.

Royal Anthropological Institute, at 8.15.—Notes on the Northern Albanians: Miss M Edith Durham.

Institution of Civil Engineers, at 8.—The Hudson River Tunnels of the Hudson and Manhattan Railroad Company: C. M. Jacobs.

WEDNESDAY, February 23.

Geological Society, at 8.—Metamorphism around the Ross of Mull Granite: T. O. Bosworth.

Royal Society of Arts, at 8.—Oxy-acetylene Welding: H. S. Smith.

British Astronomical Association, at 5.

Royal Meteorological Society (in the Physical Laboratory of the University of Manchester), at 5.—Investigation of the Electrical State of the Upper Atmosphere made at the Howard Estate Observatory, Glossop: Dr. W. Makower, A. J. Makower, and Miss M. White.—Results of the Hourly Registering-balloon Ascents from Manchester, June 2 and 3, 1909: W. A. Harwood.—Line Squalls and Associated Phenomena: R. G. K. Lempfert and R. Corless.

THURSDAY, February 24.

Royal Society, at 4.30.—*Probable Papers*: Colour-blindness and the Trichromatic Theory of Colour Vision: Sir William Abney, K.C.B., F.R.S.—Contributions to the Biochemistry of Growth: (*a*) The Total Nitrogen Metabolism of Rats bearing Malignant New Growths; (*b*) Distribution of Nitrogenous Substances in Tumour and Somatic Tissue: W. Cramer and H Pringle.—The Alcoholic Ferment of Yeast Juice: Part V., The Function of Phosphates in Alcoholic Fermentation: Dr. A. Harden, F.R.S., and W. J. Young.—And other Papers.

Royal Institution, at 3.—Illumination, Natural and Artificial: Prof. S. P. Thompson, F.R.S.

Institution of Electrical Engineers, at 8.

FRIDAY, February 25.

Royal Institution, at 9.—Colours of Sea and Sky: Lord Rayleigh, O.M., F.R.S.

Physical Society, at 5.—Telephone Circuits: Prof. J. Perry, F.R.S.—On the Laws regarding the Direction of Thermo-electric Currents enunciated by M. Thomas: Prof. C. H. Lees, F.R.S.—A New Method of Determining Thermal Conductivity: H. R. Nettleton.

Institution of Civil Engineers, at 8.—Irrigation Works: Sir R. Hanbury Brown, K.C.M.G.

SATURDAY, February 26.

Royal Institution, at 3. Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

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THURSDAY, FEBRUARY 24, 1910.

A TEXT-BOOK OF BOTANY.

Warming-Johansen, Lehrbuch der algemeinen Botanik. Herausgegeben von Dr. E. Meinecke. Zweiter Theil (Schluss). Pp. iv+481–668. (Berlin: Gebrüder Bornträger, 1909.) Price 4.80 marks.

PROF. WARMING'S book, the concluding part of which has recently been issued, will be received with interest, whilst at the same time it cannot escape some criticism. But in the latter connection the circumstances of its publication must, in fairness to the author, be kept in mind. The first part was three years in the press, and even after its appearance an interval of two years elapsed before the second and final part was issued. Botanical thought has moved rapidly during the last decade, and any text-book must naturally suffer when produced under conditions so disadvantageous as those under which Prof. Warming's book has laboured.

The earlier chapters of the first volume contain a morphological treatment of the plant on interesting lines, the ecological factors due to physical environment, &c., being kept well in sight. Many excellent figures are given, and examples are drawn from plants which are not always utilised in these matters as they might be in modern works. Some topics strike us as having been somewhat inadequately discussed, however, and especially that of phyllotaxis. If this subject is to be introduced at all (and it can hardly be omitted in a treatise such as this) one looks for more than a somewhat perfunctory account of the Braun-Schimper views.

The chapter on abstract morphology appears to us rather to miss fire—either it is too long, or it is not long, or philosophical, enough. The cell also is treated perhaps somewhat dogmatically. This may be difficult to avoid in a treatise which, while aiming at being comprehensive, is limited in size. In any event, however, there is no excuse for the introduction of the old and long discredited figure of the lily cell showing large centrosomes. This figure is the more surprising since the author himself avows his disbelief in the centrosomes as there reproduced! The section dealing with the tissue systems is good; we would willingly have seen it enlarged. Many interesting observations are worked in with the general mass of information, and the whole is admirably handled and illustrated. The general classification of the tissue systems follows that employed by Haberlandt in his well-known treatise.

The structure of the wood is well described and figured, though the difficulties (*e.g.* sliding growth) presented by the differentiation of the elements are passed over. This is, however, evidently in keeping with the main plan which the author has kept before him, of making his book chiefly informational, rather than to introduce a discussion of the many doubtful and difficult problems. Similarly, the question as to the mode of formation of annual rings only occupies a few lines.

The latter part of the first volume contains an account of the physiology of nutrition, transpiration, growth, and irritability. The matter is connected up with the life of plants in the open, and although there may be differences of opinion as to the validity of the author's views on some matters—*e.g.* the ascent of sap—everyone will probably admit that the subject-matter is treated in an interesting way. This especially applies to the section on the regulation of functions.

The first part ends in the middle of an account of the reproductive structures, and this is continued in the second and final instalment of the work. The treatment is too short to enable anything like justice to be done to this important subject, the Florideæ, for example, being dismissed with rather less than a page of print.

The morphological discussion undoubtedly loses much on account of the omission of illustrations drawn from palæontological evidence; and, again, we find a figure (476) of the germination of the pollen grain of Lilium showing centrosomes, while in the legend we read that "the centrosomes are to be neglected." Why use such a figure when there are others to choose from? Or, better still, why not draw a new one?

The chapter dealing with the life-history of the plant and its relation to external conditions is, as one would anticipate, one of the most interesting in the book, and the pages devoted to the consideration of the occurrence and significance of rhythm and of the resting periods of plants will be found to be very suggestive. Rhythm is indeed one of the most striking of physiological phenomena, and the resting period is one of its remarkable phases.

The volume ends with a brief account of the general questions which centre around heredity, variability, and such like problems. The examples are well chosen, and the student will find the discussion helpful.

The book as a whole compares well with many text-books that have appeared in recent years. It also shares some of their inevitable defects. The subject is really too large to be treated within limits of space which twenty years ago were reasonably adequate. An author who attempts to do so is bound to incur adverse criticism, and we have given, perhaps, a somewhat candid expression of our own opinion of the present work in what has gone before. But we do not intend to convey the impression that Prof. Warming has not ably discharged his task, so far as it was possible for anyone to do it.

The book is really stimulating in many ways; indeed, any work by Prof. Warming, who has done so much to initiate ecological work, could not fail in this respect; and so we leave it, passing lightly over what may be looked on as unavoidable imperfections, and congratulating the author on the chapters of his work in which he has achieved unquestioned success.

J. B. F

THE AGRICULTURE OF MODERN EGYPT.

Text-Book of Egyptian Agriculture. Edited by G. P. Foaden and F. Fletcher. Vol. i. Pp. 320. (Cairo: Ministry of Education, 1908.) Price 30 P.T.

THE introduction of agricultural schools and colleges into countries where agriculture has hitherto been nothing more than a tradition must inevitably lead to the production of a number of text-books specially written for particular countries. Although the same broad principles hold everywhere, the factors coming into play are so numerous that the student cannot apply the principles to particular cases until he has had considerable experience in the analysis of agricultural problems. He must, indeed, learn his principles through the local practices, and no matter how sound a book may be, its usefulness is very limited unless it is well furnished with local applications.

The present volume is the first attempt yet made to teach agricultural science through Egyptian illustrations. The volume before us deals with soils, irrigation, land reclamation and manures. A second volume is promised dealing with crops, fungoid and insect pests, and animals. The services of several contributors have been enlisted.

The general result is distinctly satisfactory; the student gets the kind of information he wants, and probably forms a more intelligent appreciation of the principles of his subject than would otherwise be possible. The book is also useful to the non-technical reader interested in Egypt, because of its accounts of the land-development methods now in process of application.

The opening chapter deals with the Egyptian climate and its effect on crops. Then follows a long chapter on the composition and properties of soil in relation to plants, and afterwards we turn to the more special Egyptian part, which is very interesting. The valley of the Nile is bounded by high land said to be incapable of cultivation; the population is essentially agricultural and shows no sign of emigrating southwards to the Soudan; in consequence, the agriculture of Egypt must develop on intensive lines. The area of land is being increased by reclaiming the lakes and their margins and the waste lands of the interior; it is calculated that another 25 per cent. can still be added to the present cultivatable area. Drainage, reclamation, and irrigation of land are therefore described in considerable detail. The water is either pumped or syphoned out from the lake; then the canals and drains are completed, and next the land is washed with the Nile flood to remove salt, of which all but the last 1 or 2 per cent. can be readily removed. Finally, the land is levelled to facilitate irrigation; this is done by means of a scoop, but is very expensive and laborious. It is then ready for cultivation, but as it may contain 1 or 2 per cent. of salt a small millet ("dineba"), useful for fodder, and capable of withstanding salt, may be grown as a first crop, or, if the conditions are more favourable, rice. In the Wady Tumilat a reed known as samar, and used for making mats, &c., is largely cultivated for this purpose. If dineba or rice grow successfully, the second stage may be entered upon with a crop of berseem, or Egyptian clover, which enriches the land in nitrogen and organic matter, two defects from which it suffers. The process is now complete, and cotton or other crops can be taken; the land has not, however, attained its maximum productiveness, but will go on improving for several years. Bad spots must be improved by alterations in drainage, extra washing, or ploughing.

The composition of the solid matter brought down by the Nile naturally receives attention. On an average it contains 0·13 per cent. of nitrogen while the river is in flood, but five or six times as much in the months of low Nile. Speaking generally, Egyptian soils are said to be deficient in nitrogen and also in phosphoric acid, but only occasionally in potash.

The general chapter on soils reveals a defect from which this type of book must suffer. The subject-matter is in places rather out of date, while statements are often made on very slender evidence. Far too much is made of an alleged acid excretion from the plant root; there is really no evidence that anything except carbonic acid is given off. Sulphate of ammonia is incorrectly said to be of no value as manure unless nitrifying organisms are present. Salts are stated to diffuse upwards in the soil even when there is no upward movement of the soil water. The existence in the soil is assumed of waste products of plant life injurious to other plants. Other instances might be quoted. These things can, of course, be put right in subsequent editions, but it is in the direction of keeping the strictly general and scientific matter up to date that writers of local text-books will find their chief difficulty.

THE BINNENTHAL.

La Vallée de Binn (Valais). Étude géographique, géologique, mineralogique, et pittoresque. By Léon Desbuissons. Pp. viii+328 and map. (Lausanne: Georges Bridel et Cie., 1909.) Price 10 francs.

THE Binnenthal, a valley in the south of Switzerland on the Italian border, is little known to the many English people who yearly visit that delightful country. It was "discovered" more than twenty-five years ago by a well-known member of the Alpine Club. He loved the quiet and beauty of this valley, as well as the numerous walks and climbs; when his friends asked him to describe it, his answer was, "There is no glacier there and no alpine glow," and, thanks to his reply, the valley has remained unspoilt by the tourist crowd.

For the last ten years the Binnenthal has attracted the special attention of mineralogists on account of the discovery of more than twelve minerals new to science; some of these consist only of a few minute crystals of which there is not yet sufficient material for a chemical analysis.

M. Desbuisson has produced, with the able assistance of numerous men of science and writers, a very interesting account of the natural and local history of the Binnenthal. This book contains a number of beautiful photographs and drawings by the author; especially worthy of mention are the photographs of "Les Gorges des Twingen" and "Le Hamlau de Z'Binnen"; there are also excellent maps, in the execution of which his position as Géographe du Ministre des Affaires étrangères has given him exceptional facility.

The first chapter describes the streams and waterfalls, the contour of the surrounding mountains, the valleys and passes, taking the more important mountains in separate groups. Chapter ii. deals with the geology of the district, and is accompanied with some sections after Dr. Schardt and a geological map after Prof. Schmidt and Dr. Preiswerk. Until recently this district has presented one of the most difficult geological problems in Switzerland, but through the study of the arrangement of the rocks exposed in piercing Monte Leone for the Simplon tunnel, MM. Schardt, Schmidt, and Preiswerk have been enabled to elucidate the geological difficulties of the Binnenthal district. To geologists visiting this valley, this chapter and the numerous references to other authors will be of much assistance, even though M. Desbuisson's deductions may not be entirely accepted.

Chapter iii. is devoted to mineralogy, a subject occupying nearly half the book. The number of different minerals found in this district amounts to more than eighty; of these, fourteen are new minerals found in the Lengenbach quarry. The author gives a short description of the different minerals, with references to original papers. The arrangement is puzzling, as he mixes the carbonates, the sulphates, and the oxides together, and writes calcite $CaCO^3$, siderite CO^3Fe, anhydrite SO^4Ca, barytes $BaSO^4$. There are ten plates of various crystals photographed by the author from specimens in the collections of M. Gustave Seligmann, of Coblenz, the École des Mines, Paris, and from the author's own collection. They may be interesting as records of these specimens, but are of little assistance in helping the collector to recognise these rare minerals. Photographs of minerals are seldom satisfactory, except those in Miers's "Mineralogy," which have been outlined and shaded by Miss Miers. Chapter iv. describes the history and customs of the people. This is written in a very interesting manner, and gives a vivid picture of the development of the valley and the lives of the inhabitants. References are made to that very interesting book of M. Charles Biermann, "Vallée de Conches," and to Dr. Bernouilli's account of the prehistoric remains found when enlarging the hotel at Binn. The rings, brooches, and other objects found in the graves are now preserved in a case in the hotel.

Slight mention is made of the animals and birds of the district, but a complete list of the plants is given in an appendix by Dr. A. Binz; we should like also to have seen an equally complete list of the rare and beautiful butterflies and beetles for which the Binnenthal is remarkable, and which so greatly attract the notice of entomologists. The last chapter gives a clear and accurate description of the walks and climbs, but of the latter many are too difficult and hazardous to be attempted without a guide. We may conclude by saying that this artistically written and carefully compiled account will add much to the interest and enjoyment of those visiting the Binnenthal, and we think that an abridged edition in English would be most acceptable to the English and American visitors.

HYDRAULICS.

Text-book on Hydraulics. By G. E. Russell. Pp. vii+183. (New York: Henry Holt and Co., 1909.) Price 2.50 dollars.

WITH the advent of electricity, and in the first flush of its successful application to many purposes hitherto served by water, it was claimed that the days of hydraulic power were numbered, and that ere long the study of hydraulics would lose all except merely academical interest. That such has not proved to be the case is now a matter of common knowledge, and, in fact, the rivalry between the two motive agencies can only be said to have been stimulating alike to both of them. In regard to their industrial application, there are wide and distinct fields of usefulness for each, and, rightly understood, the two sciences are collaterally valuable, and even, to some degree, complementary. Altogether, far from the relegation of hydraulics to a background of obscurity and neglect, there has, of late years, been a decided recrudescence of interest in the science which engaged the attention of philosophers more than 2000 years ago, and has been dignified by the researches of Archimedes, Bernouilli and Pascal.

Many are the text-books which have been written for the benefit of the student, and the majority of them approach the subject from a practical point of view, or, at any rate, give a decided prominence to its more utilitarian aspects. Mr. Russell considers that there is still room for a text-book dealing with principles alone, and he has accordingly restricted his work to a discussion of the "more common and important problems." This programme does not, of course, afford much scope for originality of matter nor for novelty of treatment; moreover, it does not appear that either of these was the author's intention. The object aimed at, as a matter of fact, has been to produce a book "suited for use in a number of courses" (at the Massachusetts Institute of Technology) "where the amount of prescribed time and the ground to be covered varies in each course."

The volume is divided into ten chapters, dealing with hydrostatics; the laws of fluid motion; discharge from orifices; flow over weirs, through pipes and in open channels; and the dynamic action of jets and streams. Each chapter terminates with a number of problems, the solutions of which, however, are not given; and there are useful reference lists to other literature on the subject-matter. Most of these are American and English works, and one notes casually the omission of any mention of the studies of Boussinesq. Neither is there any account of streamline flow, and the experimental researches in this connection of Reynolds and Hele-Shaw. But these omissions may be due to the restrictions imposed upon the author by the object he had in view.

For the rest, the book is written in carefully considered sequence, the type is clear, and the diagrams are excellent. There is a very useful warning in the introduction to the inexperienced student who is apt to attach exaggerated importance to the precision of numerical results obtained from data which, in themselves, are liable to errors of observation of no slight moment. The warning can hardly be over-emphasised, for the writer of this article has frequently noticed the tendency of students to pursue the solution of problems to the third and fourth decimal place when the integers alone cannot be depended upon to the extent of 10, 20, or even 50 per cent. Such fallacious exactitude is perhaps more characteristic of the study of hydraulics than of any other practical science. B. C.

WORKS ON PHYSICS.

(1) *L'Électricité considérée comme Forme de l'Énergie.* Electrostatique. Première Partie. By Lieut.-Colonel E. Aries. Pp. 176. (Paris: A. Hermann et Fils, 1909.) Price 5 francs.

(2) *Lehrbuch der Physik.* By E. Grimsehl. Pp. xii+1052. (Leipzig: B. G. Teubner, 1909.) Price 15 marks.

(3) *Elements of Physics for Use in High Schools.* By H. Crew, revised by F. T. Jones. Pp. xiv+435. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 6*s*.

(4) *Light.* By Prof. R. C. Maclaurin. Pp. ix+251. (New York: The Columbia University Press, 1909.) Price 1.50 dollars, net.

(1) As suggested by the title, the author in this pamphlet proposes to alter the present method of measuring electricity. Usually the terms "charge of electricity" and "quantity of electricity" are regarded as synonymous. Colonel Aries wishes to draw a distinction between them. The former he regards in the usual way, but defines the latter as proportional to the electrostatic energy, *i.e.* half the product of the charge and the potential. The consequence of this definition is to arrive at the result that the *quantity* of electricity associated with an insulated conductor is not constant, but varies with change of potential, although the charge is unaltered. This the author explains by assuming that the electricity (meaning the quantity—in reality the energy) streams to or fro, as the case may be, between the conductor and the surrounding dielectric.

To this change of nomenclature the objection may be raised that it leads to no useful result. But Colonel Aries suggests that in this passage of so-called electricity is to be found the explanation of the residual charge of condensers, and that it is identical with Maxwell's "displacement currents." Both suggestions are absurd. However, the treatment of the subject does not follow this point of view. Most of the ordinary theorems in electrostatics are proved by the ordinary methods, and it is a little difficult to see why the author makes the above suggestions at all. The volume is not absolutely confined to electrostatics, digressions being made into current electricity and magnetism.

(2) This book covers in some detail the whole ground usually taken in a systematic study of physics. It cannot be described as elementary, as generally understood. The standard is about that required for the pass degrees in the British universities. Were it in English it could be thoroughly recommended to students taking such courses. Recent experimental work, particularly that concerning radio-activity and electromagnetic radiations, finds a place in the section on electricity, and a number of useful tables of physical constants are given in the appendix. The notation of the calculus is used only occasionally, and in most cases, *e.g.* the estimation of certain moments of inertia, simple integrations are performed by laborious methods which avoid that notation. This, we think, is undesirable in a book of this type. If a knowledge of the calculus on the part of the student is assumed —as undoubtedly it should be in this work—it should be used consistently throughout the book.

It is gratifying to find several chapters in the beginning in which the fundamental principles of mechanics are thoroughly dealt with. The greatest difficulty encountered in the teaching of physics is insufficient training of the students in this respect. We take exception, however, to the somewhat illogical order of this section. Weight and specific gravity are defined before the questions of force and mass have been considered, and the definition of the unit of mass as "that which weighs one gram in the latitude 45°" is entirely misleading. The book is well printed, and possesses a profusion of diagrams illustrating the experiments described in the text.

(3) It is not often that we meet with a book which so admirably fulfils the purpose for which it is written as this one. It is intended for those who are just commencing the study of physics, and it is written in a way that must appeal to the student. The reason, probably, is that reference is so frequently made to those common occurrences and mechanical appliances in which the principles of physics are involved. Also, although the treatment is quite elementary, phenomena such as the diffraction and polarisation of light are not avoided, as is usually the case in text-books of this class. A further novel feature is the practice of frequently giving references to books by other authors, in cases where the student wishes for a more exhaustive treatment of a particular section of the subject. Numerous worked examples are given, and some four hundred questions are set at the end of the book.

There are only two faults we have to find. The first is connected with the question of gravitation. It is at least suggested, although not positively stated, that the value of "*g*" should be greater at the bottom of a mine than at the earth's surface. The second fault is by no means peculiar to this book. It is the erroneous view that a particle describing a circular path is in equilibrium, and subject to *two* forces, one centrifugal and the other equal and centripetal. One may ask, "How is a student to reconcile this with Newton's first law of motion?"

(4) This volume consists of ten lectures on light,

given last year by Prof. Maclaurin in the American Museum of Natural History. The subject undertaken was a difficult one, namely, to treat from a non-mathematical point of view, and in such a way as to be understood by non-physicists, the more advanced portions of the optical theory. Prof. Maclaurin has, however, successfully done this. The lectures are extremely clear and full of information. Among the subjects dealt with are colour vision and colour photography, dispersion and absorption, polarisation, interference and diffraction, and the connections between light and electricity, such as the Zeeman effect. The lectures make very good reading, and would be appreciated even by those for whom the exclusion of mathematics is unnecessary.

FUNCTIONAL PSYCHOLOGY.

(1) *Genetic Psychology. An Introduction to an Objective and Genetic View of Intelligence.* By E. A. Kirkpatrick. Pp. xv+373. (New York: The Macmillan Company, 1909.) Price 5*s.* net.

(2) *The Psychology of Thinking.* By Dr. J. E. Miller. Pp. xxv+303. (New York: The Macmillan Company, 1909.) Price 5*s.* net.

(1) THERE seems to be an ever-increasing tendency among psychologists at the present day to assimilate not only their methods of procedure, but also the schemes of description and explanation underlying their science to those employed by biology. In place of, or, more accurately, in supplementation of, the older "introspective" psychology—including "introspection under test conditions"—we now find a "functional" psychology which treats of the individual mind from the point of view, primarily, of its usefulness in adapting the individual to his environment. Both the books under consideration are written from this point of view. They are, both of them, excellent examples of the use of the biological method. Mr. Kirkpatrick tells us in his preface that all psychology must be founded on genetic principles, and studied in close relation to the facts and theories of the other sciences of life phenomena. He himself therefore commences his book with a clearly written and somewhat full account of the forms of behaviour of the lower animals, together with their structural bases, selecting types at different stages of evolution for detailed description. Not until the middle of the book does he reach the subject of consciousness "as such," and even here he deals first with its objective aspect, viz. its external effects and criteria, as exemplified by human adult consciousness. The account is excellent, and conducive to clear thinking on a difficult subject. Following this, there are chapters on "specific conscious states," "types of adaptive activity or intelligence," "types of learning activity," and "racial and individual development."

The book should prove of very considerable value to students, since it sums up a great deal of recent monograph work in most clear and interesting form.

(2) Dr. Miller's book is inspired throughout by what he aptly calls a clinical interest in the thinking process as it occurs in the child's mind, in concrete form, at the various stages of its education. The earlier chapters are devoted to a general explanation and justification of the biological point of view, and form an excellent propædeutic to the predominantly pedagogical account of thinking which follows. By those educationists—and they must surely be many—who have become dissatisfied with the quasi-logical, almost scholastic, account of the thinking process given by the older school of psychologists, the author's treatment of his subject will be found both stimulating and refreshing. Thinking is kept throughout in its correct and natural close relationship with other forms of mental activity and general organic behaviour. Not abstract schemes, but actual concrete bits of thinking, are to be found skilfully analysed and classified on every page. The continuity between the empirical thinking of animals and children and the reasoning of the trained adult mind is well brought out, together with their specific differences, and throughout the entire account the author never loses sight of the fundamental characteristic of the life process as expressed in terms of the satisfaction of needs, which is the central and controlling idea of his psychological system. The book breaks new ground in its treatment of a hitherto neglected department of psychology, and will undoubtedly be welcomed by psychologists and educationists alike. W. B.

OUR BOOK SHELF.

Das Kaninchen. Zugleich eine Einführung in die Organisation der Säugetiere. Monographien einheimischer Tiere. Vol. ii. Pp. vi+307. (Leipzig: Dr. Werner Klinkhardt, 1909.) Price 6 marks.

FOLLOWING upon an industriously compiled volume devoted to the frog, this series, edited by Prof. Ziegler, is now represented by a work on the rabbit, which we may confess at once is a disappointing one. It is little more than a new edition of Krause's well-known work, with a few additional illustrations. Indeed, though more elaborate in detail, the treatment is hardly so good as that of any of the elementary treatises in which this familiar animal has been described. There are no practical directions for actual dissection, and the figures are singularly devoid of explanatory lettering, an omission which becomes ludicrous in the case of complicated musculature. The editor has not exercised sufficient control in that important respect, nor in the treatment of the various sections, bones and muscles being allowed far too large a share in a purely descriptive work.

The book begins well, and, in fact, the introduction is its saving grace. The author treats in this opening section of the relation of the rabbit to its congeners, the differences between rabbits and hares, the various races, their habits, and history. Then follows a section upon diseases and parasites, but without any figures of the latter and without any mention of the two commonest cestodes, *Cysticercus pisiformis* and *Coenurus serialis.* Then follows an account of how to kill the creature, and, having done so, the author treats it for the whole of the rest of the work as dead. The book is a study in necrology. We are not told how the rabbit breathes or digests, or how it does anything. Are there sweat-glands? The index throws no light on the subject. What is the structure of the skin? A page near the end of the book, without a single figure to explain the heavy vocabulary, is all we are vouchsafed. The treatment of histological and embryological data is almost useless. A drawing of a sagittal section of the head raised hopes of a description of the course taken by the air in the act of breathing, but on examination the drawing itself is seen to be incomplete and to illustrate the tear-duct.

What is wanted in a modern monograph is no exclusively anatomical study of individual bones and muscles, expressed in a deterrent vocabulary, but a treatment seasoned with morphological and physiological "salt." This series is intended to help beginners, but a more strange method of doing so it would be hard to imagine. We trust that future volumes of this collection of monographs will be planned with a little more insight into the needs of biological students, and written with some feeling of the beauty as well as of the complexity of the subject.

The Irish Fairy Book. By Alfred Perceval Graves. Illustrated by George Denham. Pp. xv+355. (London: T. Fisher Unwin, n.d.) Price 6*s*.

There is a greater demand for fairy books than there is for works on folklore, and the readers differ greatly in taste and requirements. Some fairy books are worse than useless to the folklorist, books in which the authors treat their sources in a thoroughly irresponsible fashion. On the other hand, those who could handle such materials discreetly, learnedly, and reverently cannot be induced to write fairy books. But such books must be written, and Mr. Graves has produced one which is in every respect commendable.

Apart from a helpful preface and one short poem by the author or compiler, the book is a symposium by Irish writers of folk-tales, and a bare list of the writers' names shows the comprehensiveness of the work:—O'Grady, Kennedy, Allingham, Croker, Gregory, Zeats, O'Looney, Ewing, Ferguson, Joyce, McClintock, Carleton, Campbell, O'Kearney, Lover, Curtin, Wilde, Le Fann, Mangan, Hyde, Sigerson, Hull, Larminie, Boyd, Hopper, with Tennyson's "Voyage of Maeldune" as a fitting conclusion. The book is just what it was intended to be—delightful reading.

Many of the tales are in proper form for scientific examination, being evidently faithful records of oral traditions, which, with Mr. Denham's apt illustrations, are as "readable" as any in the collection. All the stories are replete with useful facts of folklore. The frequent identification of Druidism with magic is very impressive. As in Welsh folklore, the fairies are in high glee at the seasonal festivals. Puck, for instance, is definitely associated with November. Lugnassed, Lug's marriage—the old name for the August festival—survives in dialect as "Lu*nacy* day in harvest." That the framework of the tale is the calendar is in most cases fairly obvious, and one regrets that the compiler offers the reader no clue to such an interpretation in a preface where other theories are mentioned.

John Griffith.

Space and Spirit. A Commentary upon the Work of Sir Oliver Lodge entitled "Life and Matter." By R. A. Kennedy. Pp. 64. (London: C. Knight and Co., Ltd., 1909.) Price 1*s*. 6*d*. net.

This is a commentary on Sir Oliver Lodge's work, "Life and Matter," which was written primarily as a counterblast to Haeckel's "Riddle of the Universe." Its author agrees with Sir Oliver in regarding Spirit as the ultimate Reality, of which the Universe is a manifestation; but he differs on a few points of detail. Moreover, though Spirit is the "unknown reality," there is another irresolvable Absolute, viz. Space. There is a Spacial universe and a Spiritual universe. The former may only be a branch or out-leaking of the latter, but the two cannot be identified. Mr. Kennedy is, therefore, not a monist, even of the spiritual variety; he recognises two entities, and not merely two aspects of the same substance. (But is it not self-contradictory to speak of *two universes?*)

The most vital detail on which the author disagrees with Sir Oliver Lodge is that of the nature of Life. Sir Oliver, combating Haeckel's explanation of life (which gets out of the difficulty by attributing a kind of life to the atoms, in fine *petitio principii* style), Sir Oliver, we say, supposes life to flow into the carbohydrate molecule from a supernal life-reservoir, as soon as the molecule becomes sufficiently complex to accommodate it or to "let through" the properties which life can manifest. The materialist's view is that the complex aggregate has *generated* the life; he does not stop to ask what generated the complex aggregate; and Mr. Kennedy thinks that Sir Oliver is rather similarly inclined to leave the formation of the organism in its early stages to chance. "The right view surely is that life is in operation from first to last, and in fact generates the organism."

In discussions of these questions which lie on the borderland between science and philosophy, it is often apparent that divergences are verbal only. It is probably thus to some extent in the present instance. Certainly, life does not manifest itself except through complex molecules, but Sir Oliver does not leave the formation of those molecules to "chance." Rather, he would say that all matter allows intelligence and will to shine through—somewhat as taught by two men as different as Shelley and Prof. William James—from the spiritual sun which is Reality. But he is still right and consistent in denying Haeckel's assumption that atomic forces explain life, however aggregated.

The booklet is well written, and the argument is extremely acute and suggestive throughout.

Introduction to the Preparation of Organic Compounds. By Prof. Emil Fischer. Translated by Dr. R. V. Stanford. Pp. xix+175. (London: Williams and Norgate, 1909.) Price 4*s*. net.

Emil Fischer's "Anleitung zur Darstellung organischer Präparate" first appeared in 1883 in the form of autograph copies for the use of his students in the Erlangen Laboratory, and represents the first published introduction to the practical study of organic chemistry. The increasing demand led to its appearance in book form in 1887, and from it an English translation was made by A. Kling, which reached a second edition in 1895.

The book has apparently been more popular in Germany than here, for the present translation is made from the eighth German edition. This is no doubt due to the publication of more comprehensive and elaborate treatises on the same subject by English writers. But whatever the cause, the modest proportions of the volume before us do not diminish its practical value, as both teachers and students who have used it will readily admit. In this last English edition a second part is added, which is drawn from the author's researches on physiological chemistry, and is intended more especially for medical and biological students. The book is neatly bound, and printed in good type.

J. B. C.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Meaning of "Ionisation."

I AM sorry that Prof. Walker (p. 458) has avoided my question. At present I am not concerned either with his position or with mine, with van der Waals or with Newton—I wish simply to know *what exactly he would have us understand by the word ionisation.* I hold that it is our duty, as scientific workers, if possible, to be exact in word as well as deed. It is a matter of reproach to us that we should be lectured, year after year, from the chair of the Royal Society, for our carelessness as writers. Now that the attempt is being made to standardise all sorts of things—from amperes and ohms to the members of iron bridges, even by means of international congresses—we might well devote some attention to our words and attempt to standardise our scientific nomenclature. *Ionisation* is a word used with increasing frequency in these days—unfortunately also with increasing ambiguity. I would appeal to Prof. Walker, as a leader among British physical-chemists, at least to tell us what he wished us to understand when using the word recently—as his meaning is in no way made clear in his article.

HENRY E. ARMSTRONG.

The Flow of Sand.

ON Friday, February 11, I had the pleasure of hearing Mr. C. E. S. Phillips deliver the discourse at the Royal Institution, illustrated by many experiments, a number of which showed that when sand escapes from an orifice at the bottom of a long vertical tube it does not do so perfectly uniformly, but in a series of pulses which are sufficiently rapid to produce audible sounds. Mr. Phillips did not offer any suggestion as to the reason why the flow is regularly intermittent, but two of his other experiments, and the laws of friction, suggest a possible cause.

One experiment showed sand forming a cone on being poured from a funnel. The sloping sides of the cone gave the angle of repose, and it was noticed that the sand at first did not flow steadily down the slopes, but intermittently. This, I think, may be due to a combination of the momentum of the sliding sand and the difference between the statical and dynamical friction between the particles of the sand. A little heap of sand collects, then the statical friction is overcome, and the momentum carries the sand slightly too far, thus making the angle of repose too small; consequently the on-coming sand is able to remain stationary on the slope until in turn its angle of repose becomes too great, the statical friction is overcome, and the cycle is repeated. The other experiment showed how sand is self-supporting in a tube except for the cone of sand at the base. Allow this cone of sand to pass through the orifice, and the rest will fall intermittently in the manner indicated.

If this theory is correct, one would expect sand with a comparatively large coefficient of statical friction to give fewer pulses per second than a sand having a smaller angle of repose.

A. S. E. ACKERMANN.

25 Victoria Street, Westminster, London, S.W.,
February 14.

I AGREE with the explanation offered by Mr. Ackermann in the first part of his letter, for it is evident that sand must slip down itself by a series of rushes.

The process, however, by which a mass of sand falling in a glass tube produces musical sounds is somewhat more complicated. The column must be regarded as consisting of two parts, the upper portion acting simply as an intermittently moving piston. It is the central region of the lower part which becomes less dense, owing to escape of sand through the orifice; the upper portion, being no longer supported, slips downward as a whole.

The rapidity of its intermittent motion depends upon the friction between the glass and sand. Hence the pitch of the note is raised if the grains are better packed. The action appears to resemble that of pushing a moist finger-tip along a polished table. The finger jumps rapidly and regularly.

As soon as the column so far lowers that the previously compact upper portion begins to fall away at its centre, all sound ceases. I showed at the Royal Institution that by coating the inner surface of the glass tube with oil, before filling it with sand, the column moved downward by slow, regular jerks, increasing in rapidity as the mass of the remaining sand in the tube grew less. Here all friction between the glass and the sand grains was eliminated, on account of the outer layer of particles adhering to the oil and remaining as a coating upon the tube.

The jerks became more rapid as the inertia diminished with the decreasing mass, which also explains why the pitch of the note given out by a tube rises somewhat as the sand column diminishes.

CHARLES E. S. PHILLIPS.

Castle House, Shooters Hill, Kent, February 15.

The Heredity of Sex.

CURRENT Mendelian theories of the heredity of sex are based on the assumption that gametes are pure with respect to sex characters; that is, that a gamete may carry the factor for maleness or the factor for femaleness, but not both. This view may be expressed thus:—a gamete carries M, the factor (or factors) for maleness, or F, the factor (or factors) for femaleness, but not both M and F.

The hypothesis proposed in this note suggests that the phenomena of sex are due, not to a single pair of allelomorphic characters, but to two independent pairs of characters, namely, maleness (M), with its allelomorph, absence of maleness (*m*), which constitute one pair, and femaleness (F), with its allelomorph (*f*), which constitute the other pair. On this hypothesis, since M*m*, F*f* are independent of one another, representatives of both pairs of characters occur in every gamete.

All gametes are therefore of one or other of the following sex constitutions, MF, M*f*, *m*F, *mf*. Hence all zygotes produced by the pairing of such gametes are of one or other of the following nine gametic constitutions:—

$$\text{Dihybrid scheme}\left\{\begin{array}{l} \left.\begin{array}{l}1\ \mathrm{MMFF}\\ 2\ \mathrm{MMF}f\\ 2\ \mathrm{M}m\mathrm{FF}\\ 4\ \mathrm{M}m\mathrm{F}f\end{array}\right\}9\ \mathrm{MF}\\ \left.\begin{array}{l}1\ \mathrm{MM}ff\\ 2\ \mathrm{M}mff\end{array}\right\}3\ \mathrm{M}f\\ \left.\begin{array}{l}1\ mm\mathrm{FF}\\ 2\ mm\mathrm{F}f\end{array}\right\}3\ m\mathrm{F}\\ \begin{array}{l}1\ mmff\end{array}\quad\ \ 1\ mf\end{array}\right.$$

In zygotes MMFF and M*m*F*f* it may be predicted that circumstances, nutrition, &c., determine which type (male or female) of sexual organs is produced.

Thus double begonias, which bear female flowers, may be induced by starvation to bear male flowers. Fern prothalli, which bear normally male and female organs, produce, when subjected to special treatment, male organs only, and so on.

In general, the numbers of "males" and "females" among MMFF and M*m*F*f*, zygotes, will be about equal, though wide departures from equality may occur in any species owing to the prevalence of conditions which favour the production of male or female organs.

The following types of zygotes will, it may be supposed, produce male sexual organs, MMF*f*, MM*ff*, M*mff*, and the following, female organs, M*m*FF, *mm*FF, *mm*F*f*; hence the number of males will equal the number of females produced by such zygotes.

The *mmff*, pure recessive type of zygote, if viable, is sterile. The origin of sexuality connotes an origin of sterility. To give examples of the application of the hypothesis to biological facts:—

A zygote of the MF type produces gametes of which all or some carry MF. Species which have MF gametes will be capable of exhibiting parthenogenesis (natural or induced). Certain of the lower algæ produce "gametes" which may fuse in pairs to form zygotes, or may develop directly into new individuals. Those which behave in the former fashion may be such as carry M*f* or *m*F, and those which develop directly may be the MF gametes.

Among moulds, certain species of Mucor exist as several races the individuals of each of which reproduce themselves asexually, but do not conjugate with one another. When, however, individuals of different races meet, they conjugate and produce zygospores. It may be supposed that one race is of such a type as $MMff$, another of the $mmFF$ type. In this case verification of the hypothesis is possible.

The absence of sexual reproduction in various groups of fungi is to be explained on the present hypothesis as due to the extinction (or effective separation) of all zygotes except those of one type, *e.g.* the Mf or the mF types.

In homosporous ferns, the spores, produced after the reduction division, give rise each to a prothallus which bears male and female organs. If it be allowed that the reduction division is of fundamental significance with respect to the segregation of characters, it would appear to follow that current Mendelian theories of sex-heredity fail to account for the fact that a spore produced as a consequence of the reduction-division may yet carry "male" and "female" factors.

The phenomena may be interpreted simply in terms of the new hypothesis. The fern plant is MMFF; the spore, and hence the prothallus, carries MF. Therefore male and female organs may be produced by the prothallus. The gametes formed and matured in the female organs are "female," those formed and matured in the male organs are "male."

In the heterosporous ferns the spores are of two kinds, macrospores, giving rise to "female" prothalli, and microspores, which give rise to "male" prothalli. In terms of our hypothesis the sporophyte (zygote) is $MmFf$, the megaspore mF, and the microspore Mf.

Further, the high rate of mortality which accompanies spore-formation receives on this hypothesis an intelligible explanation. It is due to the inevitable reappearance of combinations of sex-characters which the heterosporous fern has ceased to tolerate.

In the light of the present hypothesis, homosporous ferns are homosporous because they are homozygous, and heterosporous ferns are heterosporous because they are heterozygous for the sex characters M and F.

The significant question arises, How far is the present limitation of characters presented by any great group of organisms determined by the fact that in this group the task of reproduction has come to be committed to some particular type or types of gametes?

The hypothesis would appear to throw light on large numbers of known facts, on prepotency, partial sterility—such, for example, as occurs in heterostylism—the apparently excessive production of pollen and ovules, and so forth.

Not only is it not repugnant to a reasonable explanation of many facts, but also the hypothesis does not seem to be inherently improbable. In that it is based on the presence and absence theory, it receives the sanction of Mendelism. It tempts the imagination to trace the origin of sexuality from the "self-contained" organisms of the MF type. Evolution in such types took, in some individuals, the form of a dropping out of the M, in others, of a dropping out of the F, factor. Such incomplete forms as Mf and Fm discovered in fusion the means of restoring their constitutions; but out of this fusion possibilities for novel constitutions arose, for the $MmFf$ type of zygote was now in being. In reproducing by segregation the original MF type of gamete, the zygote was constrained to produce likewise the other possible combinations of Mm and Ff. Fusions between the several types resulted in different forms of zygote; evolution had its chance.

Among other types, the pure recessive, $mmff$, arose, and, with its advent, sterility, and, it may be, death, came on the scene as the sinister shadow of "sexual" reproduction.

It only remains to add to this note that—in case the hypothesis it proposes prove of value—though the responsibility for the hypothesis rests with the writer, the stimulus to which it owes its inception originated, in the first place, from a study of Bateson's work on heredity, and in the second place from discussions on the problems of heredity between the writer and his colleagues, Miss Rayner, Mr. Jones, and Miss Pellew, of the botanical laboratory, to whom certain of the foregoing illustrations are due.

University College, Reading. FREDERICK KEEBLE.

Geology and the Earth's Axis of Rotation.

FROM time to time the pages of NATURE contain references to the theory which would explain the occurrence of Ice ages by a hypothetical shifting of the earth's axis of rotation. On the face of it, the theory in question appears to be capable of explaining a good deal more than this.

In the first place, if the axis of rotation were to be shifted, it seems clear that the relations between the earth's hydrosphere (or hydrospheroid) and the lithosphere must undergo change. In the regions towards which the pole is approaching land will tend to emerge from the sea, and *vice versa*. If the effects of this supposition be traced out in detail, they will be found to furnish an explanation of such phenomena as raised beaches, submerged river valleys, varying continental connections, &c., without postulating violent alterations in the lithosphere itself. Speaking merely qualitatively, the hypothesis seems to fit the facts pretty closely, *e.g.* (*a*) the height of raised beaches tends to increase as one approaches the polar regions, as it ought; (*b*) a marine transgression is associated with a warm climate.

In the second place, a shifting of the polar axis will not be without effect on the lithosphere itself, although such effect would not, presumably, under present conditions, at all resemble the effect on the hydrosphere already alluded to. Even in a rough qualitative way this effect is not easily traced out, but it seems tolerably clear that it will account for those processes of folding, &c., whereby mountain chains are built up, and also for extensive local subsidences such as are believed to have occurred in geological time. These, and doubtless other phenomena, the hypothesis explains without having recourse to the supposition that the earth has been undergoing contraction through loss of heat.

I am not aware of the existence of any publications dealing with the matters referred to, but as the subject appears to be not without interest, perhaps some of your other readers will be able to refer me to papers, &c., treating of the subject with which they may be acquainted. I should be particularly glad to be referred to researches in which the subject is treated quantitatively.

HUGH BIRRELL.

Holyrood House, Bo'ness, Linlithgowshire, N.B.,
February 4.

Secondary Cells in Tropical Climates.

ALL who have used batteries of small secondary cells in the tropics will have experienced the difficulty of keeping their cells in efficient working order, and especially in preserving the junction of separate cells from rapid corrosion. The difficulty, appreciable in Europe, becomes very serious in a climate where the laboratory temperature lies between 30° and 40° C., and for this reason—it is probable that practically all accumulators sent to tropical countries by European manufacturers are filled by their recipients with dilute sulphuric acid of a density (1,190) which corresponds to a 20 per cent. mixture in north Europe at 15° to 20° C., but at a temperature of 30° to 35° C. indicates a mixture which is far too rich in acid for the health of the cells. Some simple experiments recently carried out in this laboratory exhibit quite clearly how large a deviation from the standard 20 per cent. mixture is caused by filling cells at 30° with dilute acid of density 1,190. It is found that a density of 1,190 at 30° corresponds to a composition of 23 per cent., whereas the value of the composition accepted as giving the best results with cells of this type is 20 per cent. The difference is as much as half the total change in composition due to chemical action during the process of charging the cell.

The conclusion reached from an examination of the density-temperature curves for dilute sulphuric acid points to the advisability of filling all secondary cells in localities where the average temperature is 30° or more with acid solution of density about 1,170. Densities as low even as 1,150 have been found satisfactory for small secondary cells in the hot weather in Calcutta.

In the case of large plants in power stations, the matter may be still more important, as a cell containing too strong

an acid solution is likely, not only to live a shorter life, but to suffer sooner and more severely from sulphating and other diseases.
E. P. HARRISON.

The Physical Laboratory, Presidency College,
Calcutta, February 2.

The Invention of the Slide Rule.

DR. ALEXANDER RUSSELL's remarks on the invention of the slide rule (NATURE, January 13, p. 307) are of great interest, particularly his reference to Seth Partridge. There can be no doubt that Partridge deserves much credit for improving the rectilinear slide rule, but I see no escape from the conclusion that the real inventor of the rectilinear slide rule is the one who first made two Gunter's scales to slide together, for purposes of computation. The man who did this is Oughtred. In Mr. Sidney Lee's "Dic. of Nat. Biog.," article "Partridge, Seth," and in other publications, the incorrect statement is made that Partridge's book, "Description, &c., of the Double Scale of Proportion," first appeared in print in 1671 or 1672. I have a copy of the book bearing the date 1662. The manuscript was finished; "Saturday night, August first 1657." In 1662 Partridge's rules were manufactured, not by Walter Hayes, but by "Anthony Thompson, living in Hosier-Lane near West Smithfield, in London."

There is another point of interest. The earliest account of the rectilinear slide rule, printed in Germany, is in Leupold's "Theatrum Arithmetico-Geometricum," Leipzig, 1727, p. 71. Leupold says that he had a manuscript of ten sheets, describing it, but that he did not know the name of the author or the inventor of the instrument. Leupold's description consists of translation, word for word, of extracts from Partridge's book. Thus a historic connection is established between the rectilinear slide rule in England and in Germany.
FLORIAN CAJORI.

Colorado Springs, Colorado, February 7.

Aged Tadpoles.

THE experience of your correspondent Mr. John Don (February 17, p. 458) is no new one. More than twenty years ago we had in a small aquarium in the Charterhouse Museum a tadpole two years of age. To the best of my recollection this veteran never acquired any legs, either hind or front, but the head and body were extraordinarily large. At the present moment I have in my laboratory seven living tadpoles reared from spawn deposited last spring. Of these, three only have developed hind legs. These appendages appeared rather suddenly in December, a few days after I had supplied, for the first time, some fragments of hard-boiled egg.

The secret of procuring these aged tadpoles is to keep the animals in a vessel with vertical sides, and to afford as little opportunity as possible for them to wriggle into shallow water. I maintain a depth of about 5 inches of water in the aquarium, and find that a subdued light favours the health of the tadpoles. Sexual maturity can hardly be expected until at least the normal period has elapsed, viz. in the third or even fourth year.
OSWALD H. LATTER.

Charterhouse, Godalming, February 18.

Title of the Natural History Museum.

IN NATURE of February 17 you say (p. 465):—"No one, so far as we know, has suggested a suitable and adequate title for the [museum] at South Kensington" (devoted to natural history). This is not a difficult question; I think "British Museum of Natural History" is both suitable and adequate.
BERNARD HOBSON.

Tapton Elms, Sheffield, February 18.

THE NEW CANALS OF MARS.

THE word "new" when applied to a celestial phenomenon may be used in either of two senses. It may mean new to earthly observation, *i.e.* one which has never been seen by human beings before, or, secondly, new in itself, that is, one which has had no previous existence. New canals on Mars in the first sense, though always interesting, and at times highly important, are no novelty at this observatory, inasmuch as some four hundred have been discovered here in the last fifteen years. When Schiaparelli left his great work, he had mapped about 120 canals; with those detected here since, the number has now risen to between five and six hundred. Each of the four hundred thus added to the list, however rich an acquisition at the time it first came to be noticed, was not necessarily otherwise remarkable.

To observe, however, a canal new in the second meaning of the word, one, that is, that had never existed anteriorly, and to prove the fact, is an astronomical detection of far-reaching significance for the bearing it has upon the whole Martian question.

On September 30, 1909, when the region of the Syrtis Major came round again into view, after its periodic hiding of six weeks due to the unequal rotation periods of the earth and Mars, two striking canals were at once evident to the east of the Syrtis in places where no canals had ever previously been seen. Not only was their appearance unprecedented, but the canals themselves were the most conspicuous ones on that part of the disc. They ran one from the bottom of the Syrtis (lat. 20° N., long 285°), the other from a point part way up its eastern side (lat. 17° N., long 284°), and, curving slightly to the left as they proceeded south, converged to an oasis, itself new, on the Cocytus (lat. 5° N., long 265°), about two-thirds of the distance to where that canal meets the Amenthes. The Amenthes itself was not visible, except possibly as a suspicion. With the two main canals were associated several smaller ones, and at least two oases which had never been seen before, and from the interconnection of all of them these clearly made part of the new piece of Martian triangulation.

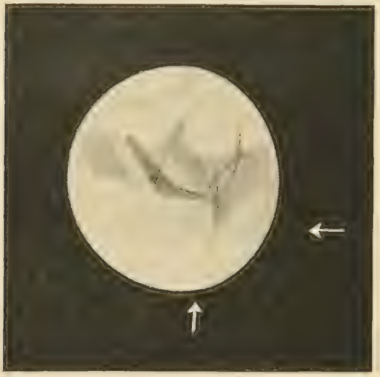
The phenomena were recorded in many independent drawings by Mr. E. C. Slipher and the director, and in the course of the next few days were photographed, appearing on the plates to the eye as the most conspicuous canals in the presentment of the planet. It is opportune that detailed photography of Mars in Mr. Lampland's skilful hands should have been so perfected as to make this possible; for the photographs taken by both Mr. E. C. Slipher and the director record these canals so that anyone may see them. There are thirty images, more or less, on each plate, and the canals appear on every image; on some more distinctly than on others, owing to the state of our air at the time, but recognisably on all; for each image had a pose of about two seconds and a half, and its definition varied according to the seeing at the time. Owing to the grain of the plate being much coarser than that of the eye, the two canals appear merged in one in the photographic images as a single line, its linear character, however, being quite distinct to one of good eyesight.

The photographs of this region taken in 1907 show no such feature.

No remembrance of ever having seen them before could be recalled by either observer, both being familiar with the planet, except that Mr. Slipher turned out to have drawn one of them the evening previous.

The record books were then examined, when it appeared that not a trace of them was to be found in the drawings of August, July, June, or May when this part of the planet was depicted. That they had not been observed in previous years was then conclusively ascertained by examination of the records of those years. The record of canals seen here is registered after each opposition in a fresh map of the planet's surface. This has been done since the beginning of the critical study of Mars at this observatory in 1894. Now, when these maps came to be scrutinised for the canals, each of them failed to show any such features. Nor had any observer previous to 1894 recorded them, as the observatory library of the subject bore witness. Schiaparelli had never seen them, nor had his predecessors or successors. This determined definitely that no human eye had ever looked upon them before. But, stirring as it is to know that one is the first to see a new geographical feature on another planet, akin to the thrill of finding unknown land in our own Antarctic regions, a much deeper scientific interest attaches to the question whether a phenomenon previously undiscovered was also previously non-existent. For in that case one has seen something come into being, with all that such origination implies.

It might seem to persons not versed in the subject that its absence on the charts was proof that a canal was itself new in the second sense because it was so in the first; but study of Mars has shown that this cannot be taken off-hand for granted. Several points must each be carefully considered. In the first place, one must be sure that the phenomenon could have been seen before, yet was not. It must be of a size which could not have escaped detection previously. Now, the great majority of canals discovered here were beyond the hope of detection elsewhere, owing to the character of the air, the improvement in instrumental means, and the long acquired knowledge of the observers. That they were not seen by Schiaparelli, therefore, by no means implies that they did not exist in his day—or even in the earlier days of observation here. We see to-day vastly more than we did in 1894, because of the experience acquired since. In the present case, however, this possibility of error was excluded by the size of the canals in question. They were not difficult detail of the order here mentioned, but, as I have said, the most conspicuous on the disc, canals which no observer of any standing whatever in good air could possibly pass by. They would strike any skilled observer of such matters the moment he looked at the planet. So far as this point went, then, they could not have existed before.



New Canals on Mars, November 4 (Prof. Percival Lowell).

The next point to be considered was whether they were results of a characteristic of the planet of vital import in its cartography—the annual seasonal change which affects all its features. For the world of Mars is as subject to recurrent seasonal change as our own, and more markedly so. This change stamps itself unmistakably upon all its features, obliterating some and bringing into prominence others according to the time of the Martian year. Examples of this occur in the study of Mars regularly at each opposition, the aspect of the disc varying according to a definite law dependent on the Martian season. To be sure, therefore, that a canal is itself new, the planet must have been previously carefully depicted at the same season of its year, and then when these earlier drawings are critically scanned the canal in question not found recorded on them. Now, the possibility of definite and conclusive intercomparison of the sort is not presented so frequently as one might think. Mars comes to opposition each time later and later by about two and a quarter of our own months. This means that we meet him in a different part of his orbit at each fresh approach, and so at a different season of his year. Now, until Schiaparelli's time, it was at or near opposition only that his face was studied. Schiaparelli extended the time greatly, but not until the subject was taken up at Flagstaff was the period of observation prolonged to six and eight months for each opposition epoch, thus enabling the same Martian season to be recurrently viewed by the seasonal overlapping of two or more observation periods.

But even so, the disc is not equally well presented in successive Martian years, because of the differing distances the two bodies are apart, and the difficulty of consequent comparison on the score of size. Still another difficulty in the way of parallelism is that of phase. Unless the two bodies be exactly opposite at the same season of the Martian year in the two cases, Mars will show a differing phase at each, and this means a different slant in the illumination. This is a very important distinction, because the disc shows very diversely when illuminated from above or from the side, so diversely that faintness of detail has often been attributed to intrinsic weakness of feature when illumination itself was the cause.

In consequence, the observer can never be quite sure that his data are comparable until he has himself seen the Martian disc under like conditions, or nearly such, which recurrent presentations demand a lapse of fifteen to seventeen years.

Furthermore, to be conclusive, the observations must all have been made by the same observer, working under like conditions, and grown, in consequence, familiar with every detail of the disc, since the personal equation, including by that term the site and the instrumental methods and equipment, is always a factor. A Martian cycle, that is, a round of about sixteen years, must have been gone through by the same observer before definite judgment can be pronounced. Such a cycle now stands complete at Flagstaff.

Examining the records here we find that Mars was observed four times previously at the same season of the Martian year as occurred during the epoch of the appearance of these two canals. The canals were seen at this opposition as follows:—

	1909	⊙	In Martian relative chronology Northern Hemisphere	Hel. long. of planet	Opposition
First appearance	Sept. 30	277°	Jan. 6	4° 50′	Sept. 23, 1909
Last observed	Dec. 12	320°	Feb. 17	47° 43′	

The previous occasions on which the canals should have been visible, if their appearance or non-appearance were a consequence of the Martian season, were:—

	☉	Martian date	Opposition
1894 Sept. 8	277°	Jan. 6	Oct. 20, 1894
to			
Nov. 18	320°	Feb. 17	
1896 July 25	277°	Jan. 6	Dec. 10, 1896
to			
Aug. 23	320°	Feb. 17	
1898 July 12	295°	Feb. 9	Jan. 18, 1899
to			
Aug. 23	320°	Feb. 17	
1907 Nov. 12	276·5°	Jan. 6	July 5, 1907
to			
Jan. 25	320°	Feb. 17	

During all these periods the planet was kept under observation at Flagstaff, and during none of them were any such canals recorded. We are, therefore, sure that seasonal change cannot explain them, and that two years ago, and also eleven, thirteen, and fifteen years ago, no such canals existed. In Martian chronology this means that not only did they not exist in their present state during the previous Martian year, but also not four, five, and six Martian years before that. It is also fairly sure that they were not in existence thirty and thirty-two years ago, inasmuch as Schiaparelli never saw them.

Lastly, a further point disclosed by the Flagstaff observations must be reckoned with, a point of very singular significance. It was long ago discovered there that (see Bulletin No. 8 of the Lowell Observatory), while the great majority of the canals are quickened into conspicuousness alternately every six Martian months, first from the south and then from the north polar cap, certain ones respond only to one or the other cap, remaining inert to the action of its antipodal fellow. To be sure, therefore, that the new canals were really new to Mars, the old drawings had to be examined on this score too. Here again the records were decisive. No such canals had ever appeared before from the quickening of either cap at the time when, had they existed then, they should have showed.

The canals in question, therefore, proved to be, not simply new canals to us, but new canals to Mars. In the canal system they are *novae* in fact or function, and as such are the most important contribution to our knowledge of the planet of recent years. For let us see what they imply. In form they are like all the other canals, narrow, regular lines of even width throughout, running with geometric precision from definite points to another point where an oasis is located. This oasis resembles all the other oases, a small, round, dark spot. They partake, therefore, of all the peculiar features of the canal system, features which I have elsewhere shown make it impossible of natural creation, that is, of being the result of any purely physical forces of which we have cognisance. On the other hand, the system exactly resembles what life there would evolve under the conditions we know to exist. The present phenomena, then, show that the canals are still in process of creation, that we have actually seen some formed under our very eyes.

Thus, on every point which had to be considered, the records furnished conclusive evidence that the canals in question could not have existed in past Martian years in the condition in which we observe them to-day. Their previous non-visibility could not have been due to any of the causes which might possibly affect it, to wit:—(1) Want of size; (2) any personal equation of the observer; (3) improved instrumental or atmospheric means; (4) distance (all these are negatived by their striking conspicuousness); (5) phase; (6) regular seasonal change; and last (7) unihemispheric seasonal change.

It will be perceived that the proof that these canals are *novae* has been possible, and only possible, through the long systematic work done on the planet here for the last fifteen years. Without such a complete system of records the certainty that the canals in question were new canals *to Mars* could not have been reached.

PERCIVAL LOWELL.

Lowell Observatory, Flagstaff, A.T.

PROPERTIES OF POLONIUM.

THE statements regarding polonium which appeared in the report from Paris reprinted from the *Times* in NATURE of February 17, must have surprised many readers to whom polonium has been a familiar substance for the last ten years. It may be of interest to review briefly our present knowledge of polonium and the bearing of the recent work of Mme. Curie and Debierne upon it.

Polonium was the first of the active substances separated from pitchblende residues by Mme. Curie. Various methods of concentration were devised by her, with the result that preparations of polonium mixed with bismuth were early obtained many thousand times more active than uranium. Marckwald later separated from 15 tons of pitchblende about 3 milligrams of intensely active material which he called radio-tellurium, since it was separated initially with tellurium as an impurity. By dipping a copper plate into a solution of this substance, he obtained a deposit of weight not more than 1/100 milligram, which was far more active than an equal weight of radium. It was soon recognised that this preparation was identical with polonium, for it gave off the typical α radiation, and had the characteristic rate of decay of that substance. Unfortunately, Marckwald was not aware at the time of separation of the great importance of testing whether lead appeared as a product of transformation of polonium. Before such an experiment could be made, the polonium had to a large extent been transformed.

Polonium is one of the numerous transition elements produced during the transformation of the uranium-radium series. It is half-transformed in about 140 days, emitting α particles during the process. Rutherford showed in 1904 that polonium was in reality a transformation product of radium itself. Radium at first changes into the emanation, and then successively into radium A, B, C, D, E, F, radium F being identical in all respects with the polonium directly separated from a radio-active mineral. When the radium emanation is allowed to decay in a sealed glass tube, the walls of the tube are coated with an invisible deposit of pure radium D, radium E, and radium F, but the amount of the latter to be obtained in this way is far too small to be weighable.

The amount of polonium present in any radioactive mineral can easily be calculated. Since the radium and polonium (radium F) in a mineral are in radio-active equilibrium, the same number of α particles are expelled from each per second. Since polonium is half-transformed in 140 days and radium in 2000 years, the former breaks up 5000 times faster than the latter. The maximum amount of polonium to be obtained from a mineral is in consequence only 1/5000 of the amount of radium. In 1000 kilos. of pitchblende containing 50 per cent. of uranium, there are present 170 milligrams of radium. The weight of polonium is about 1/5000 of this, or about 1/30 milligram. It is thus obvious that to obtain 1/10 of a milligram of pure polonium, several tons of high-grade pitchblende must be worked up. The most natural source of polonium is radium D (radio-lead), which grows polonium and has a period of half-transformation of [illegible] y years. Since polonium breaks up about [illegible] faster than radium, its activity, weight for [illegible], should be about 5000 times greater than that [illegible] um. There is nothing surprising in this, for the [illegible] am emanation has an activity about 200,000 times of radium, while radium A (period three minutes) have an activity 400 million times that of radium itself. Since the radiation from polonium is entirely in the form of α rays, it is to be expected that the radiation from it would show chemical and physical effects identical with those observed for pure emanation, the only difference being that the products of the latter emit β and γ rays as well.

Apart from the interest of obtaining a weighable quantity of polonium in a pure state, the real importance of the present investigations of Mme. Curie lies in the probable solution of the question of the nature of the substance into which the polonium is transformed. This problem has been much discussed in recent years. Since polonium emits α particles, one of its products of decomposition, as for all the other α-ray products, should be helium. The production of helium from a preparation of polonium has been observed by Rutherford and Boltwood (Manchester Lit. and Phil. Society, November 30, 1909), and also by Mme. Curie and Debierne in their present experiments. Boltwood several years ago suggested that the end product of the radium series was lead, and has collected strong evidence in support of this view by comparing the amount of helium and lead in old radioactive minerals. Since polonium is the last of the active products observed in the radium series, it is to be expected that polonium should be transformed into helium and lead, one atom of polonium producing one atom of helium and one atom of lead. This point of view receives additional weight from consideration of the atomic weight to be expected for the end product of radium. Since in the uranium-radium series, seven α particles, each of which is an atom of helium of atomic weight four, are successively expelled before radium F is reached, the atomic weight of polonium should be 7×4=28 units less than uranium (atomic weight 238·5). This gives an atomic weight of polonium of 210·5, and after the loss of an α particle, a final product of atomic weight 206·5—a value very close to the atomic weight of lead.

It is a matter of very great interest and importance to settle definitely whether polonium changes into lead. The evidence as a whole has long been in favour of that supposition. The outlook is very promising that the experiments of Mme. Curie and Debierne will settle this question conclusively. No doubt, an interval must elapse to allow the polonium to decay before the final examination of the residual substance can be made.

E. RUTHERFORD.

THE DISCOVERY OF A SKELETON OF PALÆOLITHIC MAN.

DR. CAPITAN and M. Peyrony are to be congratulated on another important discovery of the remains of Palæolithic man on September 17, at Ferrassie, in Dordogne, a locality which has been made famous by the investigations of M. Peyrony during the past decade. Here he has discovered and studied five distinct layers, each containing the artifacts and animal remains of as many well-defined epochs. In ascending order these are:—(1) Acheulian, (2) Mousterian, (3) Lower Aurignacian, (4) Middle Aurignacian, and (5) Upper Aurignacian. The skeleton, which is described by Dr. Capitan in *La Nature* for December 25, 1909, was found between the layers 1 and 2, and as these and the three upper layers were absolutely intact, it is certain that the remains belong to the Mousterian epoch. The first bones seen were the ends of a tibia and femur, and before excavating further an invitation was sent to a number of French archæologists to witness the exhumation. With infinite care and precautions, an entire skeleton was revealed. It lay on its back, with the trunk turned slightly to the left; the legs were strongly flexed, the knees being turned to the right; the left arm was extended along the side, with the hand at the hip; the right arm was flexed, the hand being near the shoulder, and the head was turned to the left, the mouth being open.

The skeleton was photographed *in situ*. Around, above, and beneath were a large number of bones which had served as food for and had been broken by the Mousterians, as well as teeth of bisons, deer, goats and reindeer; the artifacts included points, knife-scrapers, disks, hammers, and bone-breakers of quartz of the Lower Mousterian type (that is, worked on one face only).

The long and small bones were carefully removed. The pelvis, thorax and skull were severally covered with tinfoil, and plaster was poured around each, so that when the plaster set they could be removed without injury. Thus protected, they were taken to Paris without further damage or loss. The restoration, mounting, and study of the skeleton are being undertaken by Dr. Capitan. As no anatomical details have as yet been given concerning the find, anthropologists will have to wait with what patience they can muster until the investigations are completed.

The attention of readers of NATURE has been directed at various times to the recent finds of Palæolithic man, but as this is the first whole skeleton which has been obtained of a Mousterian man, the discovery is one of prime importance.

There is no reason to doubt that the body was definitely placed where it was found; probably it was placed in a corner of a large rock shelter, and covered with earth, stones, and perhaps branches. The shelter was occupied later by generations of men of the Aurignacian epoch. Finally the overhanging chalk roof fell, and its débris subsequently became covered by a layer of stones and earth five feet in thickness. Thus protected, it has remained for 20,000 years.

A. C. H.

TROPICAL AGRICULTURE.[1]

THIS work does not claim to be a handbook for the technical man, but to give information of value to students, administrators, and others on tropical crops, and at the same time to present the political and theoretical aspects of the subject.

Part i. (pp. 1–39) deals with the "Preliminaries to Agriculture." Such topics as soil, climate, labour, transport, capital, supply of water, tools, and plant acclimatisation are briefly discussed, frequently by drawing contrasts between the less known conditions of the tropics and the better known conditions of temperate regions.

Part ii. (pp. 40–141), approximately half the volume, is devoted to the "Principal Cultivations of the Tropics." This is, in our opinion, the least satisfactory portion of the book. The principal industries of Ceylon, with which the author is closely acquainted, are well done. The accounts of rice, coffee, tea, cocoanuts, and Para rubber, are admirable, although for a work dealing with the tropics as a whole Ceylon looms larger than it should, and there is a tendency to ignore methods not practised there. Thus, in a general account of coffee, the "dry" method of preparation should certainly be described, considering the extent to which it is employed in Brazil, by far the greatest coffee-producing country. The Brazilian method of preparing Para rubber is not referred to. Similarly, very scanty attention is given to crops, *e.g.* maize, Guinea corn or sorghum, and cassava, to confine attention to food-stuffs which are very important over large areas of the tropics, although, it is true, but little grown in Ceylon. In some cases condensation has been carried so far as to render the account quite inadequate, and sometimes even misleading. To give one instance, in the chapter on rubber we find: "Lagos rubber, *Funtumia elastica*, has been a little planted in some of the British West Indian and West African colonies, but as yet no rubber has been exported." From this, the sole reference to this plant, no one would realise that the tree is wild over wide areas of West Africa, and yields large quantities of exported rubber, and, moreover, that it is also wild in Uganda, whence a moderate quantity of excellent rubber has recently come on the market.

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[1] "Agriculture in the Tropics." An Elementary Treatise. By Dr. J. C Willis. Pp. xvii+222. (Cambridge: University Press, 1909.) Price 7s. 6d. net.

Striking examples of a lack of perspective are met with in the very brief notes on dyes and tans. In the former, after describing indigo and annatto, we find a list of "other dye stuffs of more or less local importance," in which occurs logwood! Cutch, from *Acacia Catechu*, is described as "perhaps the most important" of tanning substances, but why even in the brief list of other tans is there no mention of myrabolans (fruits of Terminalia, spp.)? Both are Indian tans, and in 1908, whilst the export of cutch was worth approximately 100,000*l*., that of myrabolans was nearly 400,000*l*. Several other similar instances might be quoted, and they detract considerably from what is otherwise a good, though somewhat restricted, survey of tropical agricultural industries.

Part iii., on "Agriculture in the Tropics (General)," and part iv., on the "Organisation of Agriculture," are distinctly interesting and valuable. They present the chief economic problems, including agricultural education and cooperative movements, with which the planters, administrative officers, and others have to deal, and suggest general lines along which the development of a tropical agricultural country should proceed to secure the best permanent advantage to both peasant and capitalist planter. These sections are well worth the careful study of all engaged in practically dealing with, or merely interested in, the broad administrative problems of the tropics. Such study should prevent much loss of time and money from misdirected efforts, and help to secure that continuity of policy without which even the best intentioned efforts come to naught. A book which presents these fundamental problems, and deals with them so well as Dr. Willis has done here, is a noteworthy addition to the literature of tropical agriculture.

W. G. F.

Making Copra in Samoa. From "Agriculture in the Tropics."

REFORM OF THE CALENDAR.

SENOR C. A. HESSE, of Iquique, Peru, sends us an ingenious scheme for what he calls the reform of the calendar. It has, however, nothing to do with the Julian or Gregorian styles, or any modification of the latter, now used in all Christian countries except those of the Oriental Church, which still follow the Julian usage. But it is a plan, similar to one put forth in England a year or two ago, for making the days of the week and month correspond throughout the year. This he does by dividing the year into 13 months of 28 days (or 4 weeks) each; and as that would reduce the whole year to 364 days, he proposes two intercalations, one of a zero day, and another of what he calls a double zero day.

Plans of this kind would, if adopted, cause more trouble than they would save, besides interfering with the perpetual succession of the seventh day of the week. In endeavouring to adjust the ecclesiastical calendar according to his system, Señor Hesse gives at the end a table of the dates of the feasts in 1912 as now regulated and as proposed by him. They are, indeed, inadmissible. As to taking Easter a week later, that is of less consequence; but he puts Pentecost (Whit Sunday) 54 days after Easter and 13 days after Ascension Day!

It is to be hoped that some day the whole Christian church will come to an agreement to take Easter always on the first or second Sunday in April, adjusting the other movable feasts thereby. But as regards the days of the week and year, it would be a great mistake to tinker with them; and so-called zero days would produce most serious confusion.

It is a remarkable thing that the apocalyptic book of Enoch makes the year contain only 364 days, though it must have been known, according to any probable date of the composition of even its first part, that the integral number was 365. That, not being a multiple of 52, we must adjust the days of the week as we can. To increase the number of the months would be deplorable from many points of view. It would have been better if Julius Cæsar's first proposal about the respective lengths of the twelve months had been retained rather than the subsequent modification of Augustus; but to alter this now would give much more trouble than it would save. W. T. LYNN.

NOTES.

THE paper by Captain Tilho on the French mission to Lake Chad, which was read before the Royal Geographical Society on Monday evening, February 21, contained much interesting information about the hydrography of the Chad region. On arriving in the vicinity of the lake in 1908, the mission learned that caravans were crossing on dry land the northern portion of the lake-bed, where in 1904 Captain Tilho had navigated an open expanse of water; that the central portion was merely a marsh; but that in the southern portion channels which had formerly been closed to navigation had again become practicable. Summing up the results of the mission's investigations, Captain Tilho described Lake Chad as a closed depression about four-fifths the size of Belgium, entirely independent of the rivers that flow into the Atlantic and the Mediterranean. The average depth of the lake is 5 feet. Its shores are ill-defined, the slope being so slight that small variations in the level suffice either to submerge or to leave bare large areas of the lake-bed. Even the wind may produce these results. The waters of the lake are renewed for about a tenth part by the rainfall, and for about nine-tenths by the rivers that drain into the lake, principally the Shari and the Komadugu. Losses are due to evaporation and infiltration. In the present state of knowledge it is impossible to formulate a law governing the rise and fall of the lake, but there is no reason to suppose that it is likely to disappear. A problem which has exercised the minds of geographers is whether Lake Chad occupies the lowest part of the immense plain of which it is approximately the centre. The observations of the French mission show that to the north-east of the lake there is a series of plains of considerably lower altitude. The country falls about 200 feet in a distance of less than 250 miles.

THE Rev. G. F. Whidborne, who died on February 14, aged sixty-four, was an enthusiastic amateur geologist who endeared himself to a large circle of friends. Since 1876 he had been a Fellow of the Geological Society, and for many years, as a member of council, he took an active interest in the society's affairs. He was also a member of council of the Palæontographical Society, and was several times elected a vice-president. He was interested in many lines of geological research, but devoted himself especially to the study of fossil Invertebrata. In 1883 he contributed to the Geological Society's Journal a paper on new Mollusca from the Inferior Oolite, and between the years 1888 and 1898 he published three volumes on the Devonian fauna of the south of England, included in the monographs of the Palæontographical Society. In later years he was also attracted to more general questions, and became an active member of the Victoria Institute, to the journal of which he contributed two papers. Mr. Whidborne's genial presence was always welcomed at the scientific meetings he attended, and his memory will be cherished by all who had the good fortune to be associated with him.

THE late Mr. R. Marcus Gunn, the eminent ophthalmic surgeon, devoted much of the leisure of his vacations to making a collection of fossils, which he left to the British Museum (Natural History). He worked especially in the Jurassic formations of Sutherland, and at the time of his death was engaged in the preparation of a memoir on the Jurassic flora of Brora, in collaboration with Prof. A. C. Seward, who is now completing the undertaking. He obtained many fish-remains, Mollusca, and other fossils, which form a valuable addition to the national collection. Mr. Gunn also collected from the Old Red Sandstone of Caithness, and will always be remembered for his discovery of the problematical fossil fish *Palaeospondylus gunni*, which was named after him by Dr. Traquair.

THE following awards of the Mary Kingsley medal have been made by the Liverpool School of Tropical Medicine:—Mrs. Pinnock, in recognition of the services rendered to the cause of tropical medicine and sanitation by her brother, the late Sir Alfred Jones, founder and first chairman of the school; Mr. W. Adamson and Prof. W. Carter, for assistance rendered in the foundation of the school; Prince Auguste d'Arenberg, president of the Suez Canal Company, for his campaign against malaria at Ismailia; Sir William Macgregor, Governor of Queensland, for his services to sanitation and tropical medicine while Governor of Lagos; Surgeon-General Walter Wyman, head of the Marine Hospital Service of the United States, for the organisation which he has given to the service under him and for the manner in which he has always supported scientific principles in public sanitation; Sir Alfred Keogh, recently Director-General of the Royal Army Medical Corps, for the organisation which he has given to the service under him and for the manner in which he has always supported scientific principles in public sanitation. The medal for valuable contributions to the scientific and educational side of tropical medicine has been awarded to Prof. R. Blanchard, Paris; Dr. A. Breinl, director of the Tropical Diseases Institute in Queensland; Prof. A. Celli, Rome; Dr. C. W. Daniels, director of the London School of Tropical Medicine; Surgeon-Colonel King, Indian Medical Service; Prof. Nocht, director of the Hamburg School of Tropical Medicine; Prof. G. H. F. Nuttall, Quick professor of parasitology at Cambridge University; Major L. Rogers, Indian Medical Service; Prof. J. L. Todd, associate professor of parasitology at McGill University.

BY Colonel C. R. Conder's all too early death on February 16, science and geography have suffered a great loss. When still a young subaltern of engineers he was selected to continue the survey of the Holy Land under the auspices of the Palestine Exploration Fund, and he amply justified the selection. He had a natural aptitude for surveying, and he and his assistants made an excellent survey of a large area of the Holy Land. The difficulties he had to encounter were not confined to those incident to the survey of a rugged and unmapped country; to these were added troubles with Turkish officials and with the inhabitants; but his tact and genial nature, combined with the knowledge of the people and language he soon acquired, his energy and enthusiasm, triumphed over all obstacles, and enabled him to carry out the work in a manner which reflected credit on him and on his country. His service in Palestine affected the rest of Conder's life. A man of his ability and energy naturally did not confine himself to his technical survey work and to the identification of Biblical sites. He threw himself wholeheartedly into the many questions which arose in connection with this work, and applied to them a keen and ingenious intellect and an unbounded industry. The interests and studies which Conder first took up in Palestine were pursued by him to the end of a hard-working life. While in the army his official duties were often important and arduous, but he spent almost the whole of his spare time in study and literary work connected with the Holy Land, and after his retirement he devoted himself entirely to this work. Conder spent a good many years on the congenial work of the Ordnance Survey; he did good work on some of the other varied duties of the Royal Engineers, and later on under the Irish Government, but his name will be remembered mainly through his survey, his numerous books, and memoirs on the Holy Land. The views he propounded do not command universal acceptance, but they were based on hard and conscientious work, on deep study, and on intimate personal knowledge of the Holy Land, and his works have added largely to our knowledge.

CYCLONIC disturbances have for some time past continued to arrive from the Atlantic with more than usual frequency, and since the commencement of February the British Islands have been constantly under the influence of boisterous, warm, and moist south-westerly winds, which have blown from off the open ocean. Barometrical pressure has been uniformly lower in the northern part of our area than in the south. The central areas of the disturbances have passed either to the north of Iceland or between Iceland and Scotland. The storm systems became more thoroughly developed from about February 17, when a fairly severe gale was experienced in our northern and western districts. On Saturday, February 19, another important disturbance arrived from the Atlantic, and the barometer fell considerably below 29 inches over the greater part of the kingdom, accompanied by strong gales in many places. This disturbance was passing away to the north-eastward when a fresh fall of the barometer set in on our west coasts, resulting in a very severe storm over the whole country on Sunday. The barometer at 6 p.m. was as low as 28·1 inches in the north-west of Ireland, and the mercury was below 29 inches over nearly the whole of the British Islands. The barometrical gradient was very steep in Ireland and over the southern portion of England, and the heaviest winds were probably experienced in the English Channel and over the North Sea, where, from the estimated strength of the wind, the rate attained fully 70 or 80 miles an hour. The wind reached its maximum strength on Sunday afternoon and evening, and the gale was particularly gusty. At Greenwich the anemometer registered 30·7 lb. on the square foot at 8.55 p.m.; but this force was not of long duration, the maximum force at other times during the gale being only about 23 lb. on the square foot. The gale was, however, one of the strongest experienced in recent years, and much damage was done both on land and at sea, accompanied by serious loss of life. Thunderstorms occurred on the night of February 20 in parts of England, and the whole character of the weather was extremely unsettled. Detailed accounts of the absolute wind velocity for various parts of the United Kingdom have not yet been received at the Meteorological Office, but the records when to hand will prove both valuable and interesting.

THE following officers have been elected for 1910 in connection with the Paris Bureau des Longitudes: President, Prof. H. Poincaré; vice-president, M. G. Bigourdan; secretary, M. H. Deslandres.

AT the annual general meeting of the Physical Society, held on February 11, Prof. H. L. Callendar, F.R.S., was elected president for the ensuing year; and Prof. S. Arrhenius, Madame Curie, and Prof. G. E. Hale were elected honorary fellows of the society.

SIR WILLIAM PREECE, K.C.B., Sir Joseph Swan, and Prof. G. Vernon Harcourt have been elected the first honorary members of the Illuminating Engineering Society. The first anniversary dinner of the society was held on Thursday, February 10.

AT 6.38 a.m. on February 18 a sharp earthquake was felt at Canea (Crete). The shock was accompanied by a subterranean sound and an undulating movement lasting about fourteen seconds. Several buildings were damaged in Canea and the neighbouring country. Two slight shocks were felt at Malta on the same date shortly after 6.0 a.m.

MR. A. D. HALL, F.R.S., delivered, on February 22, the first "Masters" lectures, established by the Royal Horticultural Society in memory of the late Dr. M. T. Masters. His subject was the adaptation of the soil to the plant; and he described the factors which induce a particular plant to confine itself in nature to one special type of soil, or cause a given plant to flourish in one garden while failing in another.

WE learn from the *Times* that the inhabitants of Gross-Lichterfelde, the native place of Otto Lilienthal, have decided to erect a monument to the memory of their countryman, who was amongst the earliest practical pioneers in aviation, and met his death in 1896 while making a flight at Gömberg, in the province of Brandenburg. The monument will be erected either on the hill on the slopes of which Lilienthal made his early experiments, or in the square on the bank of the Teltour Canal.

THE anniversary meeting of the Geological Society was held on Friday, February 18, when the officers were elected as follows:—*President:* Prof. W. W. Watts, F.R.S. *Vice-presidents:* Dr. C. W. Andrews, F.R.S., Mr. A. Harker, F.R.S., Mr. W. Monckton, and Prof. W. J. Sollas, F.R.S. *Secretaries:* Prof. E. J. Garwood and Dr. A. Smith Woodward, F.R.S. *Foreign Secretary:* Sir Archibald Geikie, K.C.B., Pres.R.S. *Treasurer:* Dr. Aubrey Strahan, F.R.S. The following medals and funds were presented:—Wollaston medal to Prof. W. B. Scott; Murchison medal to Prof.

A. P. Coleman; Lyell medal to Dr. A. Vaughan; Wollaston fund to Mr. E. B. Bailey; Murchison fund to Mr. J. W. Stather; Lyell fund to Mr. F. R. Cowper Reed and Dr. Robert Broom. The president delivered his anniversary [illegible] which dealt with the antiquity of man.

[illegible] port of the council was presented at the annual [illegible] ral meeting of the Institution of Mechanical Engineers on February 18. Among other matters of interest dealt with we notice that a grant of 200*l.* was made towards the cost of depositing at the National Physical Laboratory a set of British standard Whitworth- and fine-thread hardened plug screw-gauges, with other screw-gauges and measuring machines. An exhaustive research into the properties of some alloys of copper, aluminium, and manganese was completed at the National Physical Laboratory in May by Dr. W. Rosenhain, in conjunction with Mr. F. C. A. H. Lantsberry. This forms the ninth report of the Alloys Research Committee, and is now before the Institution for discussion. In view of the extremely heavy task of completely investigating a ternary system of alloys, the committee, under the chairmanship of Sir William H. White, is now limiting its researches at the National Physical Laboratory to the study of light alloys of aluminium, and is dealing, in the first place, with those containing zinc or nickel. Prof. H. C. H. Carpenter is continuing at the University of Manchester his research, referred to in the last annual report, on the production of castings to withstand high hydraulic, steam, and gas pressure. A report is expected towards the end of 1910. The summer meeting of 1910 of the institution will take the form of a joint meeting in Birmingham and London with the American Society of Mechanical Engineers. This occasion will afford members an opportunity of reciprocating the hospitality extended to them in the United States during the joint meeting of 1904.

DR. A. M. MCALDOWIE read a paper before the Cotteswold Field Club on February 15 on field-notes on certain prehistoric remains near Cheltenham. The object of the paper was to show that many of the camps and barrows on the Cotteswold Hills, such as those of Leckhampton, Crickley, Coopers Hill, and others, were used in prehistoric times for observations of the rising and setting sun at the solstices and equinoxes. By the use of a series of diagrams he showed that the position of these monuments was in many cases in remarkable agreement with the solstitial lines. In the discussion which followed, the remarkable character of these coincidences was recognised, but the opinion was expressed that the suggestion that these camps and barrows were used for solar observations before they were utilised for purposes of protection and interment of the dead was improbable. The author referred to the curious custom of planting trees on barrows, possibly as homes for the spirits of the dead, and to the fact that a right of way very commonly was found to exist leading to the more important barrows, suggesting that they were scenes of assemblages for some religious purpose in early times.

WE have to welcome the first part of a new Yorkshire natural-history journal, in the form of the Proceedings, &c., of the Hull Junior Field Naturalists' Society. It contains a reprint of Mr. J. Ritchie's paper on the occurrence of the Arctic hydroid *Selaginopsis mirabilis* in British waters, and likewise of Mr. T. Sheppard's account of a specimen of the crustacean *Eryon antiquus* from the Yorkshire Lias.

To the February number of Witherby's *British Birds* [illegible] Fagan, secretary of the natural-history branch of the British Museum, communicates a full memoir, accompanied by an excellent portrait, of the late Dr. R. B. Sharpe. In the same issue Dr. N. F. Ticehurst records the occurrence of a pair of black wheatears, or black chats (*Saxicola leucura*), at Rye Harbour between August 31 and September 16, 1909, both of which were killed. This is the first record in Britain of this south European and north African bird.

WE have received a copy of the report of the Yorkshire Naturalists' Union for 1909, reprinted from the January number of the *Yorkshire Naturalist*, from which it may be gathered that the work of that body is being carried on as energetically as ever. We have been struck by the statement that Mr. J. F. Musham "sent a brood of young pipistrelles taken in a bedroom in the Northallerton district," since this would seem to imply (although it may bear another interpretation) that the pipistrelle may produce several young at a time. Information on this point would be of interest.

IN vol. iii., part iv., of Records of the Indian Museum, Dr. N. Annandale describes and figures, under the name of *Alaptus magnanimus*, what is apparently the smallest known insect, the length of the type-specimen being only 0·21 mm. and the wing-expanse 0·85 mm. The only known specimen made its appearance in the field of vision while its describer was engaged in observing under the microscope certain organisms in oil-of-cloves. It proved to belong to the hymenopterous family Myrmaridæ, and to be nearly allied to Westwood's *Alaptus excisus*. As the insect was unlikely to be met with by any professed student of the Hymenoptera, Dr. Annandale considered that he was not justified in neglecting the opportunity of publishing a description.

Two articles in the February number of the *Popular Science Monthly* are devoted to an account of modern work on marine biology and oceanography. In the first of these Prof. C. L. Edwards gives an illustrated description of the Swedish marine zoological station at Kristineberg, near the village of Fiskebäckshil, on the west coast. Fiskebäckshil was first brought into prominence as a promising situation for the study of marine biology in 1835, and four years later Sven Lovén and others joined the colony of naturalists who were then working with the meagre resources afforded by the place. In 1877 the Kristineberg station was founded by the Danish Royal Academy of Science at the initiation of Lovén, who became director, and held the post until 1892, when he was succeeded by his friend Hjalmar Théel. The second article, by Prof. C. A. Kofoid, is devoted to the Museum für Meereskunde at Berlin, which was opened in 1906, and is designed to illustrate everything connected with the sea and its products.

THE perennial discussion as to the homology of the columella auris in Amphibia is renewed in a lengthy memoir by Messrs. B. F. Kingsbury and H. D. Reed in the *Journal of Morphology* (vol. xx., No. 4, November, 1909). This memoir constitutes the second contribution of the authors' work on the columella auris in Amphibia, and deals with the Urodela, of which a large number of types have been studied by means of serial sections. It will probably be long before unanimity of opinion is arrived at on this difficult question, but it is satisfactory to those who have been brought up in the old faith that the columella auris of amphibians is homologous with the hyomandibular of fishes to learn that this view is supported by the present detailed investigation.

Apropos of the article on colour-blindness in Nature of January 27, Mr. C. R. Gibson has forwarded us a reprint on "An Occasional Peculiarity in My Own Colour Vision" (Royal Philosophical Society of Glasgow, 1908). On three occasions he has failed to distinguish brilliant red objects or light until the colour has been accidentally brought to his notice, when the colour appears immediately to flash into his consciousness, and he experiences a feeling of amazement that he could have been oblivious to it. There is every reason to believe that, as a rule, his colour vision is normal. If this is the case, we must conclude that there is a temporary block in the transmission of the nervous impulses from the periphery to the cortex of the brain, and that the position of the block is in the higher cerebral portion of the visual path. Bordley and Cushing have recently brought forward evidence of alterations in the field of vision for colours in cases of increased intracranial pressure due to cerebral tumours. The existence of a special cortical "centre" for the perception of colours is the subject of dispute. That there must be cortical representation of the impulses engendering colour perception is a point which need not be laboured. The problem is rather that of the dissociation, or the nature of the association, of the mechanism of colour perception with that of light and form perception in the higher levels of the brain. Evidence such as that brought to our notice by Mr. Gibson helps to elucidate this problem, though more definite evidence is obtained from cases such as one admirably reported by Dr. Edwin Bramwell in the *Review of Neurology and Psychiatry* for this month (vol. viii., February). Here a cerebral abscess secondary to bronchiectasis involved the cortex of the occipital lobe, and was accompanied by fits with a visual aura and by hemi-achromatopsia.

The production of rhizoid-like processes from cells of Spirogyra filaments when growing under unnatural conditions has been recorded by several observers from De Bary onwards. Evidence has tended towards the conclusion that these are malformations, and this opinion receives confirmation in a paper, by Dr. Z. Woycicki, which appears in the *Bulletin International de l'Académie des Sciences*, Cracow (October, 1909). In this case the ill effects are attributed to the gaseous atmosphere in the laboratory. A similar formation of rhizoids was induced in cultures of *Mougeotia genuflexa*, while the injection of gas into cultures of *Cladophora fracta* produced a crop of resting spores.

It is a debated point whether modifications in plants induced by special physiological conditions can be inherited or not, and a number of experimental investigations, chiefly with lower organisms, have been made with varying results. An account of experiments with *Aspergillus niger*, carried out by Mr. K. Kominami, is published as vol. xxvii., art. 5, of the Journal of the College of Science, Tokyo University. The fungus was grown for several generations in a strong (6 per cent.) solution of common salt, and the cultures so obtained were compared with the cultures raised in normal media. With regard to germination, the conidia of the modified stock started more rapidly and strongly than those from the normal plants, and this superiority was maintained throughout ten generations. On the contrary, modifications of the organism produced in poisonous solutions did not appear to be transmitted to succeeding generations.

In connection with a variety of plants which have been found to irritate the skin when handled by gardeners and others, Mr. J. H. Maiden, Government botanist for New South Wales, has commenced to collect and summarise evidence of authentic cases. In the *Agricultural Gazette of New South Wales* (December 2, 1909) Mr. Maiden deals with a number of plants—*Oenothera biennis*, L., *Hedera helix*, L., various Primulas, *Hyacinthus orientalis*, L., and varieties, *Thuja Douglasii*, *Agave americana*, and others—quoting specific instances of the irritation caused. He states that he has found literature relating to plants which irritate the skin—other than Rhus and Primula, which he dealt with in an earlier issue of the gazette referred to—exceedingly scarce or even wanting. Mr. Maiden would be glad of references or authoritative statements as to irritation or "poisoning" caused by any wild or cultivated plants.

In the *Bulletin International de l'Académie des Sciences de Cracovie* for November, 1909, appears a paper on the mineral alstonite, by Dr. Stefan Kreutz, in which he discusses the vexed question whether this substance is a double salt or an isomorphous mixture of the three members of the group, aragonite, witherite, and strontianite. From a careful consideration of his own and earlier observations he concludes that the second view is probably correct, but acknowledges some as yet inexplicable discrepancies. He explains the complex twinning either as simultaneous twinning about both {110} and {130} or as repeated twinning about {110}, as in the case of alexandrite.

Prof. A. Woeikof contributes an extremely interesting and suggestive study of the sources of human food-supply to *La Géographie* (vol. xx., Nos. 4 and 5, pp. 225 and 281). After pointing out that the substitution of any manufactured substance for vegetable food is extremely improbable, inasmuch as plant life is capable of storing solar energy in a much more economical manner than any machine, the author emphasises the facts that scarcely any one kind of food is universally regarded as a necessary of life, while many kinds which are now regarded as necessaries by certain peoples were almost unknown to them a few generations ago. From an examination of the geographical and economic conditions, Prof. Woeikof concludes that meat will in the future become so expensive as to be practically unavailable as an ordinary food, and that the supply must sooner or later be drawn wholly from the vegetable kingdom. He is of opinion that the application of scientific methods will increase the productiveness of the agricultural land of the world to an almost unlimited extent.

In the *Atti dei Lincei* (xix., 1), Dr. Umberto gives a short note on the solution of the hydrodynamical equations for two-dimensional steady motion in a region bounded by free stream lines, the remaining spaces being occupied by fluid at rest.

Under the title of "L'Énergie," a French translation of Prof. Ostwald's classical work has been added to the new scientific series published by M. Félix Alcan, Paris, under the editorship of Prof. Borel. The translator is M. E. Philippi, and the price is 3.50 francs.

From the *Annual Register* we learn that the American Mathematical Society now consists of 618 members, as against 601 at the beginning of last year. The library now contains nearly 3300 volumes, as against between one and two hundred nine years ago. The books can be borrowed through the post by members, and one of the aims of the library is to preserve as complete a record as possible of the growth of mathematics in America.

The *Revue générale des Sciences* (xx., 23) contains a second article, by Prof. Frédéric Houssay, on the form and stability of fishes. The author has now made models representing different kinds of fish, tapering to the tail end in the form of circular or elliptic cones, and fitted with fins and tails similar to those on the actual fishes. He finds that the short conical forms are the most stable, that stability is in every case secured by means of the fins, and that for certain limits of velocity an elongated conical form becomes unstable under the conditions existing in nature.

Many who have had experience of magnetic survey work on land, but have never attempted observations at sea, will be interested in an article, by Dr. L. A. Bauer, in the December (1909) number of *Terrestrial Magnetism and Atmospheric Electricity* on some problems of ocean magnetic work. It deals with the arrangements adopted on board the United States survey ship *Carnegie* by Dr. Bauer. Each of the three instrments in use is arranged to determine two of the magnetic elements, and the reductions are made within a few minutes of the observations being taken, so that if there is any disagreement repeat observations may be taken at once. Recording and reducing are in every way facilitated by the use of printed forms, and results are to be published rapidly. Thus Dr. Bauer intends to give a summary of the voyage ending January, 1910, in the March number of *Terrestrial Magnetism*, and future work is to be dealt with in the same prompt fashion.

We have received a separate copy of a paper on two mercury manometers for small pressures, by Drs. Karl Scheel and Wilhelm Heuse, of the Physikalisch-Technische Reichsanstalt, which appeared recently in the *Zeitschrift für Instrumentenkunde*. The first of the two manometers is a slight modification of the instrument described by Lord Rayleigh in 1901. A **U**-tube provided with a bulb on each limb is filled with mercury up to the middle of the bulbs. Just above each mercury surface is a fine glass point, an image of which can be seen in the mercury. The tube is attached to a support, which can be tilted about an axis perpendicular to the plane of the tube by means of a screw, while the angle of tilt is determined by the mirror and scale method, the mirror being attached to the support. The glass points and their images are observed through a microscope. To increase the range of the instrument, in the second form of it one of the bulbs can also be moved up or down on the support by means of a screw, and the movement measured by means of a second mirror supported partly on the fixed, partly on the moving, bulb. By means of the two instruments the authors have determined the vapour pressure of water at low temperatures to a high order of accuracy.

The existence of a negative coefficient of expansion for silver iodide, first demonstrated by Fizeau, and confirmed by Rodwell, has not yet been explained by any satisfactory hypothesis. Grinnell Jones (*Zeitschrift für physikalische Chemie*, January 25) suggests that Richard's hypothesis of compressible atoms may have a bearing on this point. From this point of view the volume change of a substance owing to a rise of temperature is the algebraical sum of the volume changes, the increase of the intramolecular space owing to the increased molecular vibration, the increase due to the diminution of cohesion, and a positive or negative volume change owing to an alteration in the mutual chemical attraction of the atoms. In the present paper it is shown that the affinity of silver and iodine increases with the temperature, and it is suggested that it is the resulting contraction which causes the negative expansion coefficient of silver iodide.

In view of the extreme fewness of the insoluble salts of sodium, exceptional interest attaches to the observations of Mr. W. C. Ball, as described in the Journal of the Chemical Society (December, 1909), to the effect that the nitrite $5Bi(NO_2)_3,9CsNO_2,6NaNO_2$ is substantially insoluble in water, whilst the corresponding potassium salt is soluble. The use of bismuth-cæsium-potassium nitrite provides a reagent by means of which small amounts of sodium may be detected and estimated in the presence of large quantities of potassium—a great advance on the indirect methods that have usually been employed. The reagent is made by dissolving 50 grams KNO_2 in 100 c.c. of water, neutralising with nitric acid, and adding 10 grams of powdered bismuth nitrate. To this liquid a 10 per cent. solution of cæsium nitrate is added until the sodium present in the KNO_2 has been precipitated; the solution is then filtered, and the cæsium salt added to a total of 2·5 grams. The method may be varied to detect cæsium by the use of bismuth sodium nitrite as a reagent, the precipitate having the same composition as in the previous case; rubidium may also be detected, but the test is less sensitive.

The problem of the best method of dumping stone, dirt, or other spoil into water is of particular interest in Stockholm, where rock-blasting and removal is being carried out continually for extensions to the harbour or to the streets. We learn from a note in *Engineering* for February 18 that a new form of automatic dumping apparatus has been designed and constructed by Mr. A. F. Wiking, of Stockholm. This self-dumping barge is built with a flush deck having low bulwarks on three sides, the fourth side being either left open or provided with doors which are opened by the pressure of the load on deck when the barge tilts over for dumping. The self-tilting of the barge is obtained by forcing water, by means of compressed air, into a cylindrical tank, which is carried on tripods at a height of about 16 feet above the deck. The admission of water to this tank upsets the stability of the barge, with the result that it tilts over and discharges its load. Arrangements are also provided for returning the water from the elevated tank after dumping is completed, so as to enable the barge to return to an even keel.

The large ice-making plant recently set to work at Grimsby by the Linde British Refrigerating Company, Ltd., is described in the *Engineer* for February 18. The plant is on the ammonia compression system, and consists of two steam-driven ammonia compressors, two belt-driven treble-ram water pumps, two ammonia condensers, two can ice-making tanks and brine refrigerators, centrifugal brine-circulating pumps, electrically driven cranes, ice crushers, and elevator. There is an insulated cold store of about 13,000 cubic feet capacity, and an ice store capable of holding 1100 tons of ice, both stores being cooled by means of pipes, through which cold brine is circulated by rotary pumps. The compression plant is driven by a Morley's patent cross-compound steam engine, designed to use highly superheated steam, and is provided with exceptionally large bearing surfaces, as it has to run six or seven months at a stretch without stopping. The results of trials show 9·56 lb. weight of steam per indicated horse-power per hour when producing 208 tons of ice per day of twenty-four hours; 5·12 lb. of ice were made per pound weight of steam The ice-making performance of the plant is about 41 tons of ice per ton of coal, a very creditable performance, which has not been approached by any other type of refrigerating machinery.

Messrs. Friedländer, of Berlin, have sent us copies of seven catalogues of scientific publications, devoted, respectively, to various branches of palæontology, geography, and physiography.

Messrs. Macmillan and Co., Ltd., have published the mathematical papers for admission into the Royal Military Academy and the Royal Military College for the years 1900–9 in a single volume, the price of which is 6*s*. The book has been edited by Messrs. E. J. Brooksmith and R. M. Milne, who have supplied answers to the questions.

A second edition of "Acetylene: the Principles of its Generation and Use," by Messrs. F. H. Leeds and W. J. Atkinson Butterfield, has been published by Messrs. Charles Griffin and Co., Ltd. The original issue of the work was reviewed fully in Nature of December 10, 1903 (vol. lxix., p. 122), and it will suffice to say that the book has been revised and enlarged, an appendix including descriptions of representative acetylene generators having been added.

The second part of "A Catalogue of Books on Natural History" has been issued by Mr. Bernard Quaritch, of Grafton Street, London, W. The present part completes the general works, and this section includes scientific voyages and transactions of learned societies; and the works on zoology are also begun. We notice that the section of the catalogue concerned with entomology includes two important libraries brought together by authorities on the subject. It is expected that the catalogue will be completed in ten parts.

The St. Catherine Press, Ltd., has published a handbook to the Scandinavian winter health resorts, written by Dr. T. N. Kelynack. The substance of the book originally appeared as a series of articles in the *Lancet*. The descriptions of places are written in a bright, interesting style, and indicate that Dr. Kelynack speaks from personal knowledge derived from direct inquiry and observation. Numerous illustrations add greatly to the attractiveness of the guide, which altogether should prove of value both to physicians and patients and to holiday seekers. The price of the book is 1*s*. net.

OUR ASTRONOMICAL COLUMN.

Discovery of a New Comet, 1910*b*.—A telegram from the Kiel Centralstelle announces the discovery of a new comet by M. Pidoux at the Geneva Observatory. The position of the comet on February 20, at 7h. 10m. (Geneva M.T.), was R.A. = 0h. 46m. 22·1s., dec. = +7° 50′ 41″, and the daily motion was −2·4 m. in R.A. and −24′ in declination.

This position is in the constellation Pisces, the comet at the time of discovery being slightly east of north from δ, and a little north of west from ε, Piscium. Reference to the ephemeris for Halley's comet will show that, when discovered, this new object was apparently less than 1½° away from Halley's.

Comet 1910*a*.—The story of the discovery of comet 1910*a* is now exactly recorded, by Mr. Innes, in No. 4387 of the *Astronomische Nachrichten* (p. 311, February 12). It appears that the first intimation received by Mr. Innes arrived by a telephone message on January 15 from the *Leader*, a Johannesburg newspaper. This message stated that "Halley's comet was seen by Foreman Bourke, Driver Tricker and Guard Marais at 4h. 45m. rising in front of the sun. It was visible for about twenty minutes."

The next morning, Sunday, Messrs. Innes and Worssell kept watch, but clouds prevented an observation. The morning of January 17 was also cloudy, but there was a break just above the place of sunrise, and the comet was seen, at 5h. 29m. (standard time), by both observers independently, but by Mr. Worssell a few seconds the earlier; the telegram to Kiel was then dispatched.

Mr. Innes asks that, if seen by no one else earlier, it may be placed on record that this comet was first seen by railway officials at Kopjes, Orange Free State.

In the same number of the *Astronomische Nachrichten* Dr. Kobold gives the daily ephemeris, based on the improved elements, extended to March 12; the following is an extract:—

Ephemeris for 12h. (Berlin M.T.).

1910		α (1910·0) h. m.		δ (1910·0) ° ′		log *r*		log Δ		Mag.
Feb. 24	...	22 10·9	...	+11 55·6	...	0·05563	...	0·29959	...	5·4
28	...	22 14·6	...	+12 53·8	...	0·08681	...	0·31812	...	5·6
Mar. 4	...	22 18·1	...	+13 48·5	...	0·11505	...	0·33461	...	5·8
8	...	22 21·3	...	+14 40·5	..	0·14086	...	0·34936	...	6·0
12	...	22 24·3	...	+15 31·0	...	0·16463	...	0·36238	...	6·2

The magnitudes are based on the observation made by Prof. Hartwig on January 27 that the magnitude was then about 2·0, and by calculation the magnitude at perihelion becomes about −1·4. Observations made at Arcetri on February 7 gave corrections of +2s. and +0·4′ to the ephemeris places.

From this ephemeris we see that the comet is now apparently travelling, very slowly and in a direction slightly east of north, through Pegasus, and when it rises on the morning of March 3 it will be about 100′ north of 31 Pegasi, a fifth-magnitude star; but observations will be difficult owing to the apparent proximity of the sun.

The ephemeris also shows that the comet is retreating from the earth and sun at the rate of about two million miles per day, approximately in the direction of the earth-sun line; the present distances (February 24) are about 185 and 106 million miles respectively.

In No. 7 of the *Comptes rendus* (February 14, p. 369) M. E. Esclangon describes some remarkable transformations which he observed to take place in comet 1910*a* between January 22 and 30. On the former date the nucleus was about 15″ in diameter and very bright, and from each side of it, normally to the general direction of the tail, there appeared two currents of matter, nearly rectilinear near the source, but curving rapidly at some distance from it to form the tail. On January 30, however, the aspect was entirely changed, the nucleus being only 3″ or 4″ in diameter, and very sharply defined. The two currents of bright matter had been replaced by a circular nebulosity eccentric in regard to the nucleus; on February 9 no tail was visible. M. J. Comas Sola also communicates a paper dealing with the form of the comet, to which we hope to refer later. In a brief note M. Borrelly reports that on February 7 the comet was very faint, appearing fainter than stars of the eighth magnitude; on February 10 the magnitude was estimated as 8·5, and the comet was nearly circular, with a diameter of 2·5′.

Halley's Comet.—The following is a further extract from Mr. Crommelin's ephemeris as published in No. 4379 of the *Astronomische Nachrichten*:—

Ephemeris for Greenwich noon.

1910		R.A. h. m.		Decl. ° ′		log *r*		log Δ
March 1	...	0 34·0	...	+7 55	...	—	...	0·2774
6	...	0 30·2	...	+7 57	...	0·0397	...	0·2779
11	...	0 26·4	...	+8 0	...	—	...	0·2761
16	...	0 22·6	...	+8 2	...	9·9744	...	0·2711
21	...	0 18·5	...	+8 4	...	—	...	0·2623
26	...	0 14·2	...	+8 5	...	9·9017	...	0·2492
31	...	0 9·7	...	+8 4	...	—	...	0·2311
April 5	...	0 4·9	...	+8 1	...	9·8297	...	0·2069

These positions will be found plotted on the chart we gave in our issue of January 13 (No. 2098, p. 320), and during the greater part of April the comet will probably be unobservable. At present (February 24) the distances of the comet from the sun and from the earth are 116 and 175 million miles respectively, and the latter is increasing; but during the first week in March the earth and comet will again approach each other, until on March 31 the distance separating them will be but about 158 million miles.

In No. 419 of the *Observatory* (p. 105) Mr. Crommelin directs attention to the following parallelism of the election results of 1835 and 1910—both comet years—which is sufficiently remarkable to quote here:—

Parliaments of	...	1832	...	1906	...	1835	...	1910
Liberals ...	...	514	...	513	...	385	...	396
Opposition...	...	144	...	157	...	273	...	274

THE QUESTION OF "ABSORBING MATTER" IN SPACE.—In the January number of the *Astrophysical Journal* (vol. xxxi., No. 1, p. 8) Prof. Barnard discusses some of the "dark lanes," seen on a number of his beautiful photographs of nebulæ, from the point of view of their representing masses of actual absorbing matter. A nebulous region involving ν Scorpii is shown to be nearer than the general background of stars, and is at least partially transparent, but the absorption of the light of the stars behind it must be considerable, for it seems to show a distinct veiling tendency in certain regions. In the case of ρ Ophiuchi nebula, also, there are dark lanes which tempt Prof. Barnard to believe in the existence of opaque matter in the sky, although, if there is, it must be there, as shown on the photographs, on a gigantic scale. If it does exist, it is probably in connection, in some way, with nebulæ, for it is in nebulous regions that it is found. A magnificent photograph of the ρ Ophiuchi region is reproduced with the article, and Prof. Barnard believes that better photographs will show the nebulous region which he has photographed near π and δ Scorpii to be connected with the ν Scorpii and ρ Ophiuchi nebulosities.

PHOTOGRAPHIC OBSERVATIONS OF η AQUILÆ.—In No. 4385 of the *Astronomische Nachrichten* Herr A. Kohlschütter discusses a number of photographic observations of η Aquilæ made at Göttingen during 1906–7, and compares the results with those obtained from visual observations. This comparison shows that, essentially, the variability is the same photographically as visually, but the amplitude of the photographic variation is about 0·42 magnitude the greater.

EPHEMERIS FOR DANIEL'S COMET, 1909*e*.—A revised ephemeris for Daniel's comet (1909*e*) is given in No. 4387 of the *Astronomische Nachrichten*. Dr. Ebell, having been informed by Mr. Crommelin that the previous ephemeris, to which we directed attention last week, was incorrect, has calculated another, which he now publishes.

PRESENTATION TO SIR EDWARD THORPE, F.R.S.

AT the Government Laboratory on Friday, February 18, Sir Edward Thorpe was presented with a silver tea and coffee service and silver cigarette box subscribed for by former colleagues on the staff of the laboratory, and by members of other public departments intimately connected with the laboratory. Among the company present, besides Sir Edward and Lady Thorpe, were Sir George Murray, G.C.B., permanent secretary to the Treasury; Sir Thomas Elliott, K.C.B., secretary to the Board of Agriculture; Sir Nathaniel Highmore, Board of Customs and Excise; Mr. Middleton, Board of Agriculture; and Dr. J. J. Dobbie, principal of the Government Laboratory.

In making the presentation, Sir George Murray said he remembered being present at the opening of the Government Laboratory, and he had had ample opportunities of watching the progress of the department and the working out of what seemed in its inception to be a very novel and perhaps rather hazardous experiment. That experiment arose from a conviction that the demands of the Government on chemical science, as applied to the administrative business of government, could best be satisfied by a great central institution with an adequate equipment, and placed under the control of the most eminent man of science the Treasury could procure. The opposite idea was always dear to the hearts of departmental chiefs. They preferred a series of independent laboratories under their own control. From the moment of Sir Edward Thorpe's appointment, however, the laboratory gained the confidence of all the departments concerned, as well as of the public and the scientific world. He thought that the imposing variety of the work which was done in the laboratory could not fail to strike even the most uninstructed observer. The excellence of that work could be appreciated by only a very few.

Sir Thomas Elliott took this occasion of thanking Sir Edward Thorpe for the assistance, and more than the assistance, for the friendly advice and help that he had always shown himself ready to tender to the Board of Agriculture and Fisheries. Sir George Murray had referred to the relations between various departments, likening them to water-tight compartments. He, however, would compare them with so many foreign Powers treating with one another through the ordinary channels of diplomacy. He was sure that in overcoming such obstacles Sir Edward Thorpe showed the qualities of a statesman as well as those of a public official.

Mr. H. W. Davis, deputy principal, Mr. H. J. Helm, I.S.O., former deputy principal, and Mr. J. Connah, of the Customs branch of the laboratory, all referred to the excellent relations which had existed between Sir Edward and his colleagues, and to the great interest which Sir Edward had always taken in everything affecting the welfare of the laboratory staff.

Sir Edward Thorpe, in reply, said there was a large number of those present who could have very little conception of the difference between the old state of affairs at Somerset House and the new state in the Government Laboratory. The stars were favourable when he planned the new building, and he was glad to acknowledge the great assistance he received from individual members of his own department. The laboratory was planned, as all laboratories should be, from the inside outwards. He at once recognised that the removal from Somerset House to the new building was the opportunity for making new departures quite impossible to achieve under the old conditions. With the improvements possible in the new building, economies had been effected which practically repaid the cost of the building several times over. Sir Edward said that, apart from the routine work, several very important matters had devolved upon the laboratory which had taxed its energies to the utmost. One of the earliest arose out of the imposition of the sugar duties. The laboratory was obliged to carry out experiments upon the thermal expansion and specific gravities of glucose solutions of varying qualities, and to weld the results into tabular form. The arsenic poison scare, too, resulted in the elaboration of an apparatus for the rapid and accurate determination of infinitesimal quantities of arsenic. This apparatus had since come into official use in several countries besides our own. Further, at the present time the laboratory was, in amicable conjunction with the Brewers' Institute, engaged in a series of experiments with a view to the reconstruction and amendment of the tables upon which the method for determining the original gravity of beer is based.

A vote of thanks to Sir George Murray was proposed by Dr. Dobbie, and carried with acclamation.

BRILLIANT METEOR OF FEBRUARY 17.

ON February 17, at 6.8 p.m., a brilliant fireball was observed from various parts of the country. The evening twilight was strong, but the object created a very luminous effect; one observer, situated fully 250 miles from the meteor, estimated its light as quite three times as bright as Venus, and the streak or trail was visible for seven minutes.

Observations have come from the Thames near Sheerness, Guildford, Cardiff, and other places, and the radiant point appears to have been near Capella, from which a fine shower of February meteors is directed. The meteor was situated over Lundy Island or that region, and its height was probably from 88 to 46 miles, and velocity about 15 miles per second. As seen from Guildford, the streak remained on view nine minutes, when a cloud obscured it. It drifted far to the S.W. during its visibility, and it will be possible to compute the motion and direction of the drift very exactly.

More observations are required to define the real path with greater certainty, and amongst the large number of persons who saw the meteor it is hoped that some good records were obtained. The writer would be much interested in hearing some further particulars about the object, and especially with regard to its path in the heavens and place of the drifting streak. The meteor was probably the most brilliant observed in the British Isles hitherto this year.

W. F. DENNING.

THE HYDROGRAPHY OF THE NORTH SEA AND ADJACENT WATERS.

THE fourth report of the North Sea Fisheries Investigation Committee contains a number of papers on hydrographical researches in the northern part of the North Sea and the Færöe-Shetland channel which are of special interest, inasmuch as they provide a *résumé* of the work done since the committee began its labours, and a statement of certain results and conclusions which may now be accepted as definitely established and used as standards for comparison with future observations. These papers are:—(1) and (6) on hydrographical investigations in the North Sea and Færöe-Shetland channel during the years 1906–7–8, by Dr. A. J. Robertson; (2) on the temperature of the surface waters of the North Sea during the years 1906 and 1907, by Mr. Frank G. Young; (3) on the salinity of the North Sea, and (4) on surface-temperature observations between Hull and Hamburg during the years 1877–83, by Prof. D'Arcy Thompson; and (5) on the deep currents of the North Sea as ascertained by experiments with drift bottles, by Captain C. H. Brown. Dr. Robertson discusses the observations made during the periodic cruises executed by the SS. *Goldseeker* on lines laid down by the International Council. Mr. Young subjects to harmonic analysis temperature observations made by captains of passenger steamers and officers in charge of certain lightships and lighthouses. Prof. D'Arcy Thompson reviews in his first paper a long record of surface-temperature observations made between Hull and Hamburg by Captain W. Barron, and examines the relation of the sea temperature in the southern part of the North Sea to the air temperature of the adjacent coasts, and in his second paper gives an account of the mean values of salinity in the waters of the North Sea—the general distribution of salinity, its mean periodic variation, and the epochs of maximal and minimal salinity. Captain Brown reports upon experiments with the drift bottle devised by Mr. G. P. Bidder, which is so constructed as to float a few inches above the sea bottom, being carried along by the bottom current, and in the course of time scooped up by a trawl-net or found stranded on a beach.

In the summary which concludes his report on the observations of 1906, Dr. Robertson makes use of the results obtained by the other investigators, and lays down certain general rules. Tidal action is sufficiently active in the southern part of the North Sea to effect a thorough mixing of waters from surface to bottom; hence over this area, the northern boundary of which, by the way, seems somewhat uncertain in position, surface observations alone will henceforth be deemed sufficient. In the northern section the conditions are altogether different, and no uniformity exists in the surface to bottom distribution. Over the North Sea area the temperature decreases from the shore to the open sea in summer and increases in winter. In summer the warmest water (15° to 18° C.) occurs along the Belgian and Dutch coasts, and the coldest in the deep channel off Norway, while in winter the coldest water is, as a rule, along the Danish coast (2° to 3° C.), and the warmest between Scotland and Shetland (7° C.). The greatest annual variation at the surface occurs along the Belgian, Dutch, and German coasts, where it amounts to 13°, while between Scotland and Shetland it is some 9° less. In the deeper layers over the northern area of the North Sea the value is only 1°, while the smallest variation of all takes place in the deepest parts of the Skagerak, where it amounts to only 0·2°.

Mixing by tidal currents is so strong that water of less salinity than 33 per mille is rarely found more than a few miles from shore; over the North Sea area the variations in salinity are greatest at the surface, and the greatest mean deviation from the average occurs where salinity is lowest. In the northern area the variation seldom exceeds 0·2 per mille. The changes in salinity are thus too small to have any direct effect upon the occurrence or wanderings of food-fishes; they are mainly of interest as a guide in studying the movements of the waters.

Much information has been acquired with regard to the general circulation of the waters within the area, and the extent to which this undergoes changes of periodic and irregular kinds. Large volumes of Atlantic water are normally streaming northward as a surface current through the Færöe-Shetland channel into the Norwegian Sea, comparatively little entering the Norwegian Sea between Færöe and Iceland, where the east Iceland current comes southwards. Under exceptional conditions Polar water extends far enough south to enter the regions of the channel. (Dr. Robertson cites 1908 as one in which this occurrence was very well marked, and it was observed in 1902, as appears from Dr. Wolfenden's observations [*Geographical Journal*, April, 1903] and Dr. Robertson's report to the North Sea Committee, 1902–3 [p. 11]. The conditions observed by H.M.S. *Jackal* in 1893 were also probably somewhat similar.) The deeper layer north of the Wyville Thomson ridge is normally flooded with cold water of salinity 34·9 per mille, which is in direct connection with the bottom area of the Norwegian Sea, but in the southern parts of the channel at least these bottom layers are occasionally displaced by warmer and salter water, showing that marked changes may occur even at the greatest depths. (This also appears, from Dr. Wolfenden's observations, in the summer of 1900.)

Between the Færöes and Fair Isle the centre of the Atlantic stream is situated between 3° and 5° west longitude, where the mean annual temperature is 9·5° C. and salinity 35·29 per mille. Within the regions of the channel its direction of flow varies from north-east to east, and the speed of the surface waters apparently averages about fourteen miles in twenty-four hours. Branches are thrown off which enter the North Sea round the north and south of Shetland, and of these the latter is certainly subject to seasonal variation. A scanty winter salt-water distribution is normally followed by more vigorous inflow during early spring, increasing to a maximum in the beginning of summer, and gradually decreasing again on the approach of the following winter. As exceptional seasons, Dr. Robertson quotes (1) the winter 1905–6, when an unusually powerful Atlantic inflow took place; (2) the summer of 1907, when the maximum inflow was unduly delayed; and (3) the whole of 1908, when the inflow was very scanty.

The greater proportion of the Atlantic water entering the northern part of the North Sea area bends eastward before reaching the 57th parallel of latitude, and after throwing off a branch which enters the Skagerak as an undercurrent is carried back northwards. This rotational movement, due to the configuration of the bottom, gives rise to a cold, deep-water area, an area with a great temperature phase delay over which the maximum value in the bottom layers is not reached until near the close of the year. (This layer appears in the *Jackal* observations, 1893.) A fresh-water current continually streams northward along the Norwegian coast, being exclusively confined to the in-shore regions during the winter months, but extending in summer far out to sea as a thin surface layer; similar movements occur in summer off the Scottish coast.

From the above summary of Dr. Robertson's conclusions it appears that the normal distribution and circulation of the waters in the North Sea area may now be regarded as definitely known. The departures from the normal are, as was supposed, very considerable, but it would seem that the years 1905–6 and 1908 may be taken as representing the nature of the extreme variations which are likely to occur, and it is noteworthy that the older observations of H.M.S. *Jackal* and other vessels indicate conditions which, while showing some abnormal features for the years to which they refer, agree satisfactorily with the more recent and more adequate work as regards the type of distribution and general movement, and fall within the limits of departure from that type which they have themselves recorded.

H. N. Dickson.

THE THOMSEN MEMORIAL LECTURE.[1]

AMONG the Danes whose names are inscribed as men of science on the eternal bead-roll of fame, that of Julius Thomsen stands pre-eminent—linked indeed with that of Oersted. It is significant of the position which Thomsen acquired in physical science, and of the respect which that position secured for him in the eyes of his countrymen, that his statue should have been erected during his lifetime and placed in the vicinity of that of Oersted in the courtyard of the Polytechnic High School of Copenhagen. Thomsen, in fact, played many parts in the intellectual, industrial, and social development of Denmark. To Europe in general he was mainly known as a distinguished man of science. By his fellow-citizens he was further recognised as an educationist of high ideals, actuated by a strong common sense and a stern devotion to duty; as an able and sagacious administrator; as a successful technologist and the creator of an important and lucrative industry based upon his own discoveries; and as a man of forceful character, who brought his authority, skill, and knowledge of men and affairs to the service of the communal life of Copenhagen.

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[1] Delivered before the Chemical Society on February 17, by Sir Edward Thorpe, C.B., F.R.S., past-president of the Society.

Thomsen was a municipal councillor of that city for more than a third of a century. He occupied a commanding position on the Council, and was invariably listened to with respect. The gas, water, and sewage works of Copenhagen are among the monuments to his civic activity. From 1882 up to the time of his death he was a member of the Harbour Board of the port. In these respects Thomsen sought to realise Priestley's ideal of the perfect man—that he should be a good citizen first and a man of science afterwards.

Hans Peter Jürgen Julius Thomsen was born in Copenhagen on February 16, 1826. He was educated at the church school of St. Peter in that city, and subsequently at von Westens Institute. In 1843 he commenced his studies at the Polytechnic, and in 1846 graduated there in applied science, and became an assistant to Prof. E. A. Scharling. Of his earliest years comparatively little is known. Thomsen, always a reserved and taciturn man, talked little about himself even to his intimate friends—and least of all about the days of his youth. It was known to a few that these days had not been smooth. Those who were best informed were conscious that to these early struggles much of that dour and resolute nature which formed a distinguishing trait in his character was due. Thomsen, indeed, began life as a fighter, and a fighter he remained to the end of his four-score years.

In 1847, he became assistant to Forchhammer, passing rich, like Goldsmith's pedagogue, on 40*l.* a year. Georg Forchhammer, whose earliest work dates back to the period when Berzelius was in his prime, was an active and industrious investigator of the old school, mainly in inorganic chemistry, and more particularly on problems of chemical geology and physiography. He was a frequent visitor to this country, and was well known to early members of the British Association. Although doubtless influenced, in common with all teachers in northern Europe, by the example and methods of Berzelius, such influence as he himself was able to exert died with him. Forchhammer attracted few pupils, and created no school, and Thomsen probably derived no inspiration or acquired any stimulus from this association. For a time Thomsen supplemented his scanty income by teaching agricultural chemistry at the Polytechnic. In 1853 he obtained a travelling scholarship, and spent a year in visiting German and French laboratories. He probably owed this scholarship in great measure to his first contribution to the literature of chemistry, namely, his memoir, "Bidrag til en Thermochemisk System" (contributions to a thermochemical system), communicated to the Royal Society of Sciences of Copenhagen in 1852, and for which he received the silver medal of the society and a sum of ten guineas to enable him to procure a more accurate apparatus. In this memoir he sought to develop the chemical side of the mechanical theory of heat, doubtless under the influence of Ludwig Augustus Colding, an engineer in the service of the Municipality of Copenhagen, and a pioneer, like Mayer, in the development of that theory. Indeed, the Danes now claim for Colding, who had made experiments on the relation between work and heat as far back as 1842, but whose labours were practically ignored by his contemporaries, the position which the Germans assign to Mayer (see Mach's "Development of the Theory of Heat"). In 1861 Thomsen further developed his ideas in a memoir on the "General Nature of Chemical Processes, and on a Theory of Affinity Based Thereon," published in the Transactions of the Danish Academy of Sciences. In this paper he laid the foundations of the chief scientific work of his life.

In 1853 Thomsen patented a method of obtaining soda from cryolite, so-called "Greenland," or ice-spar, a naturally occurring fluoride of sodium and aluminium, $Al_2F_6,6NaF$, found largely, indeed, almost exclusively, in Greenland, and particularly at Ivigtut. It derives its mineralogical name from its ice-like appearance and ready fusibility even in the flame of a candle. It seems to have been first brought to Europe in 1794, and to have been described by Schumacher in the following year. Klaproth first showed that it contained soda, and its composition was further established by Vauquelin, Berzelius, and Deville.

Thomsen's process consists in heating a finely divided mixture of cryolite and chalk in a reverberatory furnace, whereby carbon dioxide is expelled and calcium fluoride and sodium aluminate are formed. The roasted mass is lixiviated with water, so as to dissolve out the sodium aluminate, which is then treated with carbon dioxide. Alumina is precipitated, and sodium carbonate remains in solution. The alumina is either sold as such or converted into sulphate (co-called "concentrated alum" or "alum-cake"), and the sodium carbonate is separated by crystallisation. Both products are obtained in a remarkably pure condition, and the cryolite-soda yields excellent "caustic."

Thomsen's process, although simple enough in principle, requires considerable skill and pains in its practical execution, and most of the manufacturing details were worked out by him, or under his direction. Success largely depends upon the maintenance of a proper temperature; the decomposition begins below a red-heat, but requires to be finished at that temperature, and care must be taken to avoid fusion or even sintering of the mass. In 1854 Thomsen obtained the exclusive right of mining for cryolite and of working up the mineral in Denmark for soda and alumina. Actual manufacturing operations were begun on a small scale in 1857, and in the following year Thomsen planned the present large factory at Oeresund, near Copenhagen, which was opened on his thirty-fourth birthday. The importance of this industry to Denmark may be seen from the circumstance that during the fifty years of its existence the firm have paid the Danish Government nearly 300,000*l.* for the concession. Other factories were started in Germany, Bohemia, and Poland, but met with little success. The Pennsylvania Salt-manufacturing Company at Natrona, near Pittsburg, eventually obtained the right to work up two-thirds of all the cryolite mined in Greenland. From the start Thomsen took a large share in the management of the Oeresund works, and by his energy, foresight, and skill placed the undertaking on a sound commercial basis.

Although Thomsen died a rich man, mainly as the result of the industry he created, in the outset of his career as a teacher and a technologist his means were very straitened. He came of poor parents, of no social position or influence, and they were unable to further his inclinations towards an academical career. In 1854 he applied unsuccessfully for a position as teacher of chemistry at the Military High School in Copenhagen. During three years—from 1856 to 1859—while still engaged in developing his cryolite process, he acted as an adjuster of weights and measures to the Municipality of Copenhagen. It was a poorly paid position, but it kept the wolf from the door. At about this period he betook himself to literature, and published a popular book on general subjects connected with physics and chemistry—somewhat in the style of Helmholtz's well-known work—entitled "Travels in Scientific Regions," which had a considerable measure of success. He was, however, not altogether unknown even at this time as an author, since in 1853 he had collaborated with his friend Colding in producing a memoir on the causes of the spread of cholera and on the methods of prevention, which attracted much attention at the time of its appearance.

In 1859, whilst engaged in the Oeresund factory, he again applied to the authorities for a position as teacher at the Military High School, and succeeded in obtaining an appointment to a lectureship in physics, which he held until 1866. During his tenure of this office he devised his polarisation battery, which received many awards at international exhibitions and was used for a time in the Danish telegraph service.

In 1859–60 he was "vicarius" for Scharling at the University, and in 1865 became a teacher, and in the following year professor of chemistry and director of the

Chemical Laboratory, a position which he retained—active to the last—until 1901, when he retired in his seventy-fifth year of age.

Before his connection with the University, he founded and edited, from 1862 to 1878, in association with his brother, August Thomsen, the *Journal of Chemistry and Physics*, one of the principal organs of scientific literature in Denmark.

In 1863 he was elected a member of the Commission of Weights and Measures, and was instrumental in bringing about the adoption of the metric system and the assimilation of the Danish system to that of the Scandinavian Kingdom.

In 1883 Thomsen became Chancellor of the Polytechnic High School of Copenhagen—a position which he held for about nine years. During this period he entirely changed the character and spirit of the school, and stamped it with the impress of his earnestness and industry. Under his direction, new buildings were erected and arranged in accordance with the best Continental and American models. Thomsen's administration was in marked contrast to that of his somewhat easy-going predecessor, but it is doubtful if it brought him popularity in the school. The students respected and even feared him, but his cold and unsympathetic nature evoked no warmer feeling. It was said of him by one who knew him intimately that he never learned to draw the young to him, to create in them an interest for his work, to form a school. Thomsen was a homely man, but not even in his home, says the same authority, was it possible for him to change his active, earnest, strenuous disposition—what his friends called his fighting character. But if he was always the serious master of the house, he was also its obedient servant. In reality he was a man of deep feeling, and was not without power to give that feeling expression in words, sometimes in verse, and occasionally even in music.

It was while occupying the position of director of the chemical laboratory of the University that Thomsen executed the thermochemical investigations which constitute the experimental development of the ideas he had formulated in his memoir of 1861. The results of these inquiries were first made known in a series of papers published from 1869 to 1873 in the Transactions of the Royal Danish Society of Sciences, and from 1873 onwards by the *Journal für Praktische Chemie*. The papers were republished in collected form in four volumes (1882–1886) by a Leipzig house under the title of "Thermochemische Untersuchungen." A summary of this experimental labour, which extended over a third of a century, was subsequently prepared by Thomsen, and published in 1905 in Danish under the title of "Thermokemiske Resultater."

In this work he reviewed the whole of the numerical and theoretical results, to the exclusion of the greater portion of the experimental details. A translation of this volume by Miss Katharine A. Burke, entitled "Thermochemistry," renders it readily accessible to English readers. Miss Burke has supplemented the original work by a short account, taken from the "Thermochemische Untersuchungen," of the experimental methods employed, thereby rendering the whole more intelligible to the student. Moreover, in the English edition a partial attempt has been made to translate Thomsen's deductions into the language of modern theory based on the conception of ionisation, which, of course, was not known to science at the time the "Thermochemische Untersuchungen" was published.

It is impossible within the limits of such a notice as this to deal in detail with the immense mass of experimental material which this work embodies, and I shall not attempt, therefore, to do more than to offer a generalised statement, based mainly upon the admirable account of Thomsen's work given by Prof. Brönsted to the Chemical Society of Copenhagen on the occasion of the meeting held on March 2, 1909, to commemorate Thomsen's services to science.

The conception of affinity as a cause and determining condition of chemical change is traceable in some of the earliest efforts to coordinate and explain chemical phenomena. It certainly existed long prior to the time of Boyle, and was at the basis of every philosophical system after his period. We need only mention the names of Bergman, Wenzel, and Berthollet to indicate this fact. But to Thomsen belongs the credit of being the first to make the attempt to measure the relative value or strength of affinity quantitatively, and to express it numerically in definite terms which admitted of exact comparison. Thomsen's theory of affinity, as enunciated by him in his 1851 paper, was based upon his conviction that affinity could be measured quantitatively by estimating the amount of heat evolved in the chemical process. We are not immediately concerned to show whether the theory is right or wrong, or in what respect it fails. The point is that the enunciation of this principle upwards of half a century ago constituted an important step forward, inasmuch as it sought to estimate affinity in relation to a quantity which can be fixed by experiment, and is capable of expression by numbers. In this and in the subsequent paper of which mention has been made already, he thus defines his conception of thermochemistry, and discusses, for the first time, its laws.

"The force which unites the component parts of a chemical compound is called affinity. If a compound is split up, whether by the influence of electricity, heat, or light, or by the addition of another substance, this affinity must be overcome. A certain force is required the amount of which depends on the strength of the affinity.

"If we imagine, on the one side, a compound split up into its component parts, and on the other side these parts again united to form the original compound, then we have two opposite processes the beginning and end of which are alike. It is therefore evident that the amount of the force required to split up a certain compound must be the same as that which is evolved if the compound in question is again formed from its component parts.

"The amount of force evolved by the formation of a compound can be measured in absolute terms; it is equal to the amount of heat evolved by the formation of the compound.

"Every simple or complex action of a purely chemical nature is accompanied by evolution of heat.

"By considering the amount of heat evolved by the formation of a chemical compound as a measure of the affinity, as a measrue of the work required to again resolve the compound into its component parts, it must be possible to deduce general laws for the chemical processes, and to exchange the old theory of affinity, resting on an uncertain foundation, for a new one, resting on the sure foundation of numerical values."

As has been proved by later theoretical and experimental investigations, the theory of thermochemical affinity is not absolutely correct at ordinary temperatures. But, on the other hand, it has been shown that a comparatively large number of processes are approximately in unison with it. Not only do they agree qualitatively, that is to say, that heat is evolved during the process, but also in the fact that the results which newer and more exact methods for estimating affinity have produced agree numerically with what would be required by the thermochemical theory. We meet here with a fundamental phenomenon which Thomsen deserves great credit for having first pointed out, but the explanation of which could not be given at the time he indicated it. It can be demonstrated theoretically that the lower we reduce the temperature and the nearer we get to the absolute zero, the more nearly is the condition for the theory fulfilled, so that at the absolute zero the theory would be found to be an exact law of nature. If it were possible to work at such low temperatures it would be found that the evolution of heat, or the evolution of energy by the chemical process, would be an exact measure of the affinity of the process and that under this condition the theory of Thomsen would be the accurate expression of a natural law.

But under ordinary conditions this is not so, for in reality an ever-increasing number of endothermic processes are found to occur, that is, processes which proceed with the absorption of heat. Thomsen tried at first to explain these phenomena in such a way as to keep them within his system, and he drew a distinction between a purely chemical process running conformably to his theory and a physico-chemical process which did not fall within the law. But he was gradually convinced that his theory could not be maintained in its entirety. It is to his credit that he did not seek to uphold an untenable principle, or try to defend it as did Berthelot, who almost to his dying day maintained the validity of the principle in spite of all facts.

These ideas have, in the words of Ostwald, been the scientific confession of faith of chemists throughout half a century. They have had the greatest influence on scientific thought in every branch of chemistry. It is on the basis of them that we have arrived at a theory of affinity which at the present moment is being developed into one of the most perfect chemical theories. Lastly, it is due to these ideas that the experimental material has been produced which during all time will place the name of Julius Thomsen in the first rank of men of science.

To go through this material in detail is, as I have said, impossible here. It may be stated generally that practically every simple inorganic process has been investigated calorimetrically by Thomsen, or can be calculated by means of the calorimetric data furnished by him. In the case of organic substances, data have been given for estimating the heat of combustion of a large number of compounds. All these estimations were made by Thomsen personally, according to a pre-arranged plan, and in systematic succession during a period of more than thirty years. They comprise more than 3500 calorimetrical estimations. It has been truly said that this work is unique in the chemical history of any country.

Among the results of Thomsen's thermochemical inquiries which have special value for physical chemistry is his investigation of the phenomena of neutralisation, in which he shows that the basicity of acids can be estimated thermochemically, and that it can in this way be proved whether or not a point of neutrality exists. His observation that the heat of neutralisation is the same for a long series of inorganic acids, such as hydrochloric acid, hydrobromic acid, hydriodic acid, chloric acid, nitric acid, &c., supports the theory of electrical dissociation, inasmuch as this requires that the heat of neutralisation of the strong acids must in all cases be independent of the nature of the acid, because the process of neutralisation for all of them is the combination of the ion of hydrogen in the acid with the ion of hydroxyl of the base to form water. These investigations also led to the important thermochemical result that the heat of neutralisation of acids (or the heat of their dissociation) cannot be considered as a measure of the strength of the acids.

Another important result is the proof by experiment of the connection which exists between the changes of the heat-effect with the temperature and the specific heat of the reacting substances. The first law of thermodynamics requires the relation indicated by Kirchhoff: $dU/dT = C_1 - C_2$, where U is the heat-effect, T the temperature, and C_1 and C_2 are the heat capacities of the two systems before and after the reaction, and Thomsen showed by investigation of the heat of neutralisation, the heat of solution, and the heat of dilution, that this relation was satisfied. For the purpose of his inquiry, the specific heats of a large number of solutions of salts were estimated by an ingenious method, and with an exactness hitherto unattained.

Of no less importance are Thomsen's thermochemical investigations on the influence of mass. In the year 1867 Guldberg and Waage published their theory of the chemical effect of mass. But they had only verified the theory to a small extent and in particularly simple cases. They had not investigated the complete homogeneous equilibrium, because at that time no method existed for experimental investigation of such homogeneous equilibrium. Thomsen showed that the estimation could be made thermochemically. By allowing, for instance, an acid to act on a salt of another acid in an aqueous solution, the latter acid will be partly replaced by the first, which will form a salt. By mixing, for instance, a solution of sodium sulphate and nitric acid, there is formed sodium nitrate and sulphuric acid, but the process will not proceed to completion. If we have estimated the heat of neutralisation of the two acids with sodium hydroxide, the difference between these two heat-phenomena will give the amount of heat corresponding to the total decomposition of the sodium sulphate, and the heat found experimentally by mixing the two solutions will therefore show to what degree the transformation has taken place. It would be possible to estimate thermochemically the amount of the four substances in solution, and thereby, by varying the concentration or the proportion between the initial quantities of substances, to calculate whether the Guldberg-Waage theory on the effect of mass was confirmed in this case.

Thomsen applied this method to a large number of different acids and bases, and was enabled thereby to prove the agreement with the law of the influence of mass in all the cases which he examined. He found particularly that the proportion of the one acid which remained combined with the base was constant with mixtures of constant proportion. On this basis he propounded the term *avidity*, which he defined as the tendency of the acid to unite with the base, and he showed that the avidity was independent of the concentration, and only to a small extent varied with the temperature. The term avidity has since acquired great importance, particularly since other and more exact methods for its estimation have been found. Concurrently with this, its meaning has been made clear by the theory of electrolytic dissociation.

On the basis of these estimations, Thomsen drew up the first table, based on experiments, of the relative strength of the acids, and the numbers in this table have been found to agree with the results obtained by examining the electrical conductivity of the acids.

It is worth noting that Thomsen not only produced the experimental proof of the correctness of the Guldberg-Waage theory of the effect of mass soon after the appearance of this theory, but also that he was the first to acknowledge and adopt it. It is remarkable that this work of Thomsen received so little attention, although it appeared in a widely circulated German journal, and it was not until ten years later that the law of the effect of mass was generally recognised, as the result of the work of Ostwald and van 't Hoff.

Although Thomsen's title to scientific fame rests mainly upon his thermochemical work, his interests extended beyond this particular department of physical chemistry. He worked on chloral hydrate, selenic acid on ammoniacal platinum compounds, and on glucinum platinum chloride, on iodic acid and periodic acid, on hydrogen peroxide, hypophosphorous acid, and hydrogenium. He early recognised the importance of Mendeléeff's great generalisation, and contributed to the abundant literature it produced. His paper of 1895, "On the Probability of the Existence of a Group of Inactive Elements," may be said to have foreshadowed the discovery of the congeners of argon. He pointed out that in periodic functions the change from negative to positive value, or the reverse, can only take place by a passage through zero or through infinity; in the first case, the change is gradual, and in the second case it is sudden. The first case corresponds with the gradual change in electrical character with rising atomic weight in the separate series of the periodic system, and the second case corresponds with a passage from one series to the next. It therefore appears that the passage from one series to the next in the periodic system should take place through an element which is electrically indifferent. The valency of such an element would be zero, and therefore in this respect also it would represent a transitional stage in the passage from the univalent electronegative elements of the seventh to the univalent electropositive elements of the first group. This indicates the possible existence of a group of inactive elements with the atomic weights 4, 20, 36, 84, 132, the first five numbers corresponding fairly closely with the atomic weights respectively of helium, neon, argon, krypton, and xenon (*Zeitsch. anorg. Chem.*, 1895, ix., 283; Journ. Chem. Soc., 1896, lxx., ii., 16). He subsequently made known the existence of helium in the red fluorite from Ivigtut.

As evidence of Thomsen's manipulative ability and his power of accurate work may be mentioned his determination of the atomic weights of oxygen and hydrogen, and incidentally of aluminium. For the atomic weight of hydrogen he obtained the value 1·00825 when O=16, which is practically identical with that of Morley and Noyes. He further made most accurate estimations of the relative densities of these gases, and of the volumetric ratios in which they enter into the composition of water. His value for the atomic weight of aluminium is nearly identical with that adopted in the last Report of the International Committee on Atomic Weights.

Thomsen maintained his interest in thermochemical problems up to the end, and was a keen and clear-sighted critic of the work which appeared from time to time during the later years of his life. This interest occasionally gave rise to controversy, and some of his latest papers were wholly polemical.

Thomsen was a pronounced atomist, and to him a chemical process was a change in the internal structure of a molecule, and the chief aim of chemistry was to investigate the laws which control the union of atoms and molecules during the chemical process. He considered that chemistry should be treated mathematically as a branch of rational mechanics. But no one insisted more strongly than he how little we really know of these questions. In summarising his theoretical ideas in the *Thermokemische Resultater,* he says, "An almost impenetrable darkness hides from us the inner structure of molecules and the true nature of atoms. We know only the relative number of atoms within the molecule, their mass, and the existence of certain groups of atoms or radicles in the molecule, but with regard to the forces acting within the molecules and causing their formation or destruction our knowledge is still exceedingly limited." He fully realised that his own work was only the foundation on which the future elucidation of these questions must rest. "He worked," says Brönsted, "in the conviction that what we somewhat vaguely call the affinity of the atoms—their interaction, their attraction, and varying effect, &c.—follows the general laws of mechanics, and that, as he worded it, the principle that 'might is right,' holds good in chemistry as in mechanics. On this foundation he hoped to be able to evolve the laws for the statics and dynamics of chemical phenomena, even although the true nature of the action is unknown."

Thomsen's merits as an investigator received formal recognition from nearly every country in the civilised world. So far back as 1860 he was elected one of the thirty-five members of the Danish Royal Society of Sciences of Copenhagen, and from 1888 until his death he was its president. In 1876 he became an honorary foreign member of the Chemical Society of London. On the occasion of the fourth centenary of the foundation of the University of Upsala (created in 1477), he received the degree of Doctor of Philosophy *honoris causa.* In 1879 he was made an honorary M.D. of the University of Copenhagen. Two years later he was made a foreign member of the Physiographical Society of Lund, and in 1888 he was elected a member of the Society of Science and Literature of Gothenburg. In 1885 he became a member of the Royal Society of Sciences of Upsala, and in 1886 of the Stockholm Academy of Sciences.

In 1883 he and Berthelot were together awarded the Davy Medal of the Royal Society—a fitting and impartial recognition on the part of the society of the manner in which the two investigators, whose work not infrequently brought them into active opposition, had jointly and severally contributed to lay the foundations of thermochemistry.

In the same year Thomsen was made a member of the Accademia dei Lincei of Rome, and in the following year he was elected into the American Academy of Arts and Sciences in Boston, and of the Royal Academy of Sciences of Turin. In 1887 he was made a member of the Royal Belgian Academy.

In 1886–7, and again in 1891–2, he was rector of the University of Copenhagen. In 1888 he became Commander of the Dannebrog, and in 1896, and on his seventieth birthday, he was made Grand Commander of the same order. On the same occasion the Danish chemists caused a gold medal to be struck in his honour. In 1902 he became a Privy Councillor (Geheime Konferenz raad). In the same year he was elected a foreign member of the Royal Society of London.

He died on February 13, 1908, full of years as of honours, and was buried on the eighty-third anniversary of his birth and on the jubilee of the opening of the Oeresund factory. His wife, Elmine Hansen—the daughter of a farmer on Langeland—predeceased him in 1890.

I desire to express my acknowledgments to Director G. A. Hagemann, of Copenhagen, and to Prof. Arrhenius, of Stockholm, for their assistance in obtaining information concerning Thomsen's personal history. I am also much indebted to our fellow, Mr. Harald Faber, for his kindness in making for me a translation of Prof. Brönsted's account of Thomsen's scientific work, on which my own *résumé* is mainly based.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Sir J. J. Thomson has been nominated to represent the University at the celebration next October of the centenary of the University of Berlin.

Mr. S. Brodetsky, bracketted senior wrangler in 1908, has been elected to the Isaac Newton studentship, tenable for three years.

The adjudicators of the Smith's prizes and Rayleigh prizes are of opinion that the following essay sent in by a candidate is of distinction, "Discontinuous Motion in Gases," by Mr. G. I. Taylor. A Smith's prize is awarded to Mr. Taylor for this essay. The second Smith's prize is not awarded.

In response to an appeal for funds for the purpose of purchasing a site and for building, equipping, and conducting a field laboratory on the outskirts of Cambridge, mainly for the study of protozoal and parasitic diseases, donations amounting to 988*l.* 17*s.* have been received. A donation of 1000*l.* has been promised, anonymously, when the fund has reached 6000*l.* In addition to the foregoing, the Government of Cape Colony has placed the sum of 500*l.* at the disposal of Prof. Nuttall for the purpose of investigating East Coast fever. By permission of the Government, a part of this sum will be utilised for the construction of the laboratory.

OXFORD.—The fact that Halley occupied the Savilian chair of astronomy at Oxford gives this University a special interest in Halley's comet. This interest the University proposes to mark by conferring the honorary degree of Doctor of Science on Mr. P. H. Cowell, F.R.S., chief assistant, and Mr. A. C. D. Crommelin, assistant, at the Royal Observatory, Greenwich, by whose joint calculations the exact determination of the re-appearance of Halley's comet was successfully accomplished. The actual ceremony of conferring the degree will probably take place in May, at the time when the comet is expected to be at its brightest. It has further been arranged that the first discourse given on the new foundation of the Halley lecture shall be delivered by the founder himself, Dr. Henry Wilde, F.R.S., and it is hoped that this may take place at the same time as the conferring of degrees on the two Greenwich astronomers.

ST. ANDREWS.—Besides the munificent gifts to the chemical department of the University already noted, Dr. Purdie recently handed 2000*l.* to the University Court to aid in paying a chemical assistant.

Prof. Percy Herring (physiology) has been appointed dean of the faculty of science, and he enters on his duties at the end of the winter session, the pro-dean (Prof. Butler) meanwhile officiating during the enforced retirement of Prof. Musgrove from illness.

The spacious new Pettigrew Museum of Natural History (the gift of Mrs. Pettigrew) is approaching completion, and the hothouses and conservatories in connection with the botanical department, to which Mrs. Pettigrew also liberally contributed, are well advanced.

A JOINT conference of members of the Geographical Association and of the Federated Associations of London Non-primary Teachers will be held at 3 p.m. on Saturday, March 12, at the Polytechnic, Regent Street, W., when an address will be given by Mr. H. J. Mackinder on "The Regional Method in Geography." Tickets may be obtained from the honorary secretary of the Federated Associations, Miss R. F. Shove, 26 Blessington Road, Lee, S.E.

EDUCATIONAL and charitable institutions, says *Science,* have received 32,400*l.* by the will of the late Mrs. Frances E. Curtiss, of Chicago. Among the institutions which have benefited is Williams College, Williamstown, Mass., 5000*l.* Cooper Medical College, San Francisco, has received a bequest of 1000*l.* by the will of the late Mrs. Myrick. In connection with these bequests to higher education, it is interesting to note that our contemporary reports President Schurman, of Cornell University, as having said in a recent address: "I should like most to see at Cornell a score of research professorships with salaries, say 1500*l.* each, which would call for a capital of some 600,000*l.* or 800,000*l.*, a really small amount in this age of American multi-millionaires."

The issue of "The Public Schools Year Book" for 1910, which is now available, is the twenty-first, and the coming of age of this useful annual publication is marked fittingly by its adoption by the Headmasters' Conference as their official book of reference. The first part of the work is devoted to the proceedings of the Headmasters' Conference and to full information relative to the public schools. The second part deals with entrance scholarships at the public schools, entrance examinations to the universities, and the conditions of admission to the Navy, Army, Civil Service, and other professions, including engineering and chemistry. A general list of preparatory schools where young boys may be prepared for admission to a public school is also included. To parents proposing to send a boy to one of the public schools, the year book will prove invaluable, since the information respecting the organisation and instruction, fees and other charges, and so on, is just what they will require.

A recent table prepared for the London County Council Education Committee provides instructive particulars as to the ages of the boys and girls in the London secondary schools aided by grants from the Council. During the educational year 1909–10 there were in attendance in these schools 9244 boys and 5468 girls. Of the 9244 boys, 2131 were under 12 years of age, 1589 between 12 and 13 years, 1786 between 13 and 14 years, 1767 between 14 and 15 years, 1191 between 15 and 16 years, 465 between 16 and 17 years, 224 between 17 and 18 years, and 91 were more than 18 years. As regards the 5468 girls, 1467 were under 12 years of age, 896 were between 12 and 13 years, 863 between 13 and 14 years, 922 between 14 and 15 years, 805 between 15 and 16 years, 327 between 16 and 17 years, 154 between 17 and 18 years, and 34 above 18 years. In other words, only 780 of the total number of boys in the London secondary schools aided by the Council, or only 8·4 per cent., are above 16 years of age, and only 515 of the total number of girls in the schools, or 9·4 per cent., are above 16 years of age. It must be remembered that, with the exception of the greater public schools, the majority of the public secondary schools in London receive aid from the rates, and consequently it has to be admitted that the number of boys and girls receiving what may be called a complete secondary education is very small.

The London County Council aids upwards of fifty secondary schools in London. The grants are paid partly with the view of enabling the schools to accommodate a larger number of pupils than would otherwise be possible, and partly with a view of increasing the efficiency of the work. The income of the "aided" schools is derived from four main sources—endowment, Board of Education grant, fees, and grant from the London County Council. The total amounts of these sources of income for the educational year 1908–9 were as follows:—Endowment, 52,533*l.*; Board of Education grant, 49,818*l.*; fees, including fees of London County Council scholars, 114,334*l.*; and the Council's grant, excluding the fees of scholars, 41,415*l.*; making a total of 258,100*l.* It is estimated that during the present educational year the amounts will be:—Endowment, 53,190*l.*; Board of Education grants, 57,678*l.*; fees, 120,963*l.*; and Council's grant, 40,346*l.*; bringing the total up to 272,177*l.* In the case of each "aided" school, the Council requests the governors to submit a statement of receipts and expenditure for the completed year, and also an estimate of the receipts and expenditure for the coming year, and the grant made by the Council is estimated to be sufficient, together with endowments, fees, and Board of Education grant, to admit of the efficient carrying on of the school, and to provide a reasonable working balance throughout the educational year.

The prospectus for the current session of the Pusa Agricultural Research Institute gives particulars of the courses available for students in agricultural chemistry, economic botany, economic entomology, mycology, agricultural bacteriology, and agriculture proper. The work in each of these departments is respectively under the supervision of the Imperial agricultural chemist, economic botanist, entomologist, mycologist, agricultural bacteriologist, and agriculturist, who act under the principal as chiefs of the teaching staff. In the absence of experience of the class of student likely to be received, it has been found impossible to lay down a permanent syllabus of the training in each subject. The syllabuses are, for the present, tentative, and subject to the condition that time will not be wasted in taking students over ground that is already familiar to them. It may be remembered that the Pusa Agricultural Research Institute owes its inception to the generosity of Mr. Henry Phipps, who in 1903 placed at the disposal of Lord Curzon, then Viceroy of India, a donation of 20,000*l.* (which he afterwards raised to 30,000*l.*) with the request that it might be devoted to some object of public utility in India, preferably in the direction of scientific research. Part of this donation was devoted to the construction of a Pasteur institute at Coonoor, in southern India, and it was decided that the balance should be utilised in erecting a laboratory of agricultural research to form a centre of economic science in connection with that occupation on which the people of India mainly depend. This conception was subsequently enlarged, and the Government of India has now constructed a college and research institute, to which a farm of some 1300 acres is attached, for purposes of experimental cultivation and demonstration. The Pusa Institute is consequently in a position to enable students who have passed with distinction through a course at a provincial college, by means of a post-graduate course in one of the specialised branches of agricultural science, to qualify for the higher branches of agricultural work.

Replying to the toast of his health at the annual dinner of the Bristol University Colston Society on February 17, Sir William Ramsay, K.C.B., spoke of the administration of British universities. Professors should not, he said, be paid less than the average income obtainable in kindred professions. If a professor is paid at a much lower rate than he would obtain by entering some corresponding profession, it means that persons of one of three classes will occupy chairs. First a few men, from love of teaching or research, will carry on work on a pittance. Secondly, there are the men with a competence, who will take professional work for the love of it. They are few. The third result of underpayment is that professorial chairs will be filled with men of mediocre talent and capacity; students will suffer, and generations, as they succeed one another, will deteriorate. Scholarships, he continued, are mostly a waste of money. The bestowal of scholarships is not always a failure; but if granted as loans on the evidence of the power of application and good conduct, the money can, in most cases, be bestowed more profitably. What the public wants to buy, or should want to buy, is the educated brains of one who will in future prove useful to the State. The present method is one by which the article is uncertain and the price paid incommensurably high, owing to the high percentage of failures in attaining the standard of mind which the public has a right to demand. If the money distributed in scholarships were applied to the development of universities, England's universities would be rich.—The question of adequate remuneration for professors is to some extent a question of ways and means; until more money is forthcoming in this country for the purposes of university and higher education generally, there seems little possibility that the emoluments of men engaged in teaching and research will be increased. British universities seem unable to arouse the generosity of our men of wealth to the same extent as has been done in the United States, for instance. We notice in *Science* for February 11 that in one week donations were announced of 50,000*l.* to the Sheffield Scientific School of Yale University, 200,000*l.* for the establishment of a teachers' college, and 90,000*l.* for the general purposes of higher education. A few gifts on this scale would soon make it possible to remedy the defect to which Sir William Ramsay directs attention.

New science laboratories at St. Leonard's School, St. Andrews, N.B., were opened by Sir Ernest Shackleton on February 1. The building comprises two large laboratories each 34 feet by 30 feet, a lecture theatre to seat sixty pupils, a room for the preparation of experiments by the science mistresses, a dark-room for work in optics, a conservatory for botanical experiments, a cloak-room, and a spacious corridor, to be fitted with dust-proof museum cases. The chemical laboratory, which is also to be used for practical work in geography, is fitted with six benches, at each of which four girls work. The tops of the benches have been kept as clear as possible, carrying only Bunsen burners and two movable trays, each of which can hold ten reagent bottles. These trays, with the bottles they contain, fit into cavities in the sides of the benches, so that the tops can be cleared in a moment when required for practical geographical work. The reagent bottles are double-labelled, so that they can be used by two pupils working opposite each other. Attached to the front of the demonstrator's bench is a shelf, which hangs vertically when not in use. This has been designed for the purpose of holding the apparatus required for the lesson, and two girls from each bench come to this dispensing shelf and take from it all they require for their experimental work. The laboratories are both supplied with many light trays of varying sizes, each capable of holding a dozen beakers, flasks, burettes or pipettes, &c. These trays fit into the bench cupboards. Neither cupboards nor drawers have been set apart, as is usual, for the individual use of the pupils except in the case of the more advanced students, as experience has shown that they are apt to become receptacles for burnt matches, corks, soiled filter papers, &c. Placed in each stool recess is a shelf which holds a trough, test-tube rack, tripod, and retort-stand. The same principle has been observed in the fittings of the physical and botanical laboratory. The fume cupboards, of which there are four—two in the chemical laboratory, one in the physical laboratory, and one between the lecture theatre and the preparation room—are all supplied with both gas and water. The building is fitted throughout with electric light. In the lecture theatre there is an electric lantern, and a part of the cream-coloured wall acts as the screen, and allows a picture 10 feet square. This room is fitted with dark blinds, and ventilated, when these are in use, by means of an electric fan. In the conservatory are benches at which the pupils work when fitting up apparatus for botanical experiments. The usual precautions have been taken against accident by fire, and Minimax fire extinguishers stand in prominent positions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 13.—D. P. **Phillips**: Re-combination of ions at different temperatures. The ionisation was produced in a layer of air of uniform thickness by means of a single discharge through a Röntgen bulb. The layer of air ionised was situated midway between two parallel electrodes, and was separated from each by a layer of un-ionised air. The quantity received by each electrode depends upon the field established between them, and from the variation of the quantity with the field the coefficient of re-combination can be calculated. By placing the pair of electrodes in a double-walled jacket the temperature was varied, and the coefficient of re-combination found at different temperatures. The values which were found are:—

Temp. Centigrade ...	16°	100°	155°	176°	273°
Coeff. of Re-combination	1·00	0·50	0·399	0·36	0·178

The value at the temperature of the room, *i.e.* at 16°, was taken as unity, and the other values were compared with this. The object of having the layer of ionised air separated from the electrodes by un-ionised air was to decrease the number of ions reaching the electrodes by diffusion, and so causing an apparent increase in the re-combination. With this arrangement the effect of diffusion would be to decrease the apparent re-combination. In order to test the magnitude of the error introduced by diffusion, the thickness of the ionised layer of air was altered, and the coefficient of re-combination determined for each thickness. At each temperature it was found that the coefficient of re-combination apparently falls off when the thickness of the layer is reduced below a certain value. Thus it was shown that in this experiment the diffusion was negligible up to 176° C., but that at 273° C. it probably caused a serious reduction in the apparent value of the re-combination.

Sir Edward **Thorpe** and A. G. **Francis**: The atomic weight of strontium. The principle of the methods employed consisted in determining the ratios of the weights of strontium bromide and chloride and of pure silver and of the silver halides respectively. The strontium salts, $SrBr_2$ and $SrCl_2$, purified by fractional crystallisation and precipitation, were fused in a stream of dry halogen acid and allowed to solidify in dry nitrogen. While the halides were still warm the nitrogen was replaced by dry air and the salts transferred to the weighing flasks. The fused salts were ice-like in appearance, and yielded perfectly clear neutral solutions in water. The silver needed to precipitate completely the halogen was dissolved in a specially devised burette, so contrived that the solution could be delivered without loss to the strontium solution. After eighteen hours the slight excess silver left in solution was titrated with a solution of strontium halide of known strength. Finally, the silver halide was dried, fused, and weighed. The apparatus was so devised that these operations could be done without removing the silver salts from the vessel in which it was formed. As an independent check, the ratios of $SrBr_2$ and $SrCl_2$ to $SrSO_4$ were also determined by converting the strontium halides into strontium sulphate by direct treatment with sulphuric acid. The possible sources of error are discussed, and all known corrections were applied. In all, six series of observations were made. The mean results are as follows:—

Series A.	$2Ag : SrBr_2$ (6 exp's.) ...	87·645±0·0037
,, B.	$2AgBr : SrBr_2$ (5 expts.)... ...	87·653±0·0045
,, C.	$2Ag : SrCl_2$ (6 expts.)	87·642±0·0017
,, D.	$2AgCl : SrCl_2$ (5 expts.)	87·645±0·0020
,, E.	$SrBr_2 : SrSO_4$ (3 expts.)	87·629±0·021
,, F.	$SrCl_2 : SrSO_4$ (4 expts.)	87·661±0·0078
Mean of A, B, C, D	...	87·646±0·0016
,, E, F	... ...	87·645±0·0107
,, A, B, C, D, E, F	... ...	87·646±0·0029

The authors adopt 87·65 as the definite value for the atomic weight of strontium—a number only 0·03 in excess of Richards's final value as given in the last report of the International Committee on Atomic Weights.

February 17.—Sir Archibald Geikie, K.C.B., president, in the chair.—E. **Marsden**: Phosphorescence produced by α- and β-rays.—Prof. E. **Rutherford**: Theory of the luminosity produced in certain substances by α-rays.—Dr. H. **Geiger**: The scattering of the α-particles by matter. In a previous note on the same subject experiments have been described which gave direct evidence of the scattering of the α-particles in passing through matter. These experiments have been continued with the object of determining quantitatively the amount of scattering under various conditions. In particular the influence of the thickness and nature of the scattering material and of the velocity of the α-particles has been studied in detail. With the exception of a few modifications, the experimental arrangement was the same as that employed in the preliminary experiments. A strong source of homogeneous α-radiation was placed at one end of a long tube, and the α-particles, after passing through a narrow circular opening, fell upon a zinc sulphide screen sealed to the other end of the tube. When the pressure inside the tube was very low the scintillations produced by the impact of the α-particles on the screen were confined to a very small area. When, however, the α-particles were intercepted by a thin sheet of metal, the scintillations were spread out over a much greater area, this being due to the scattering of the α-particles when passing through the metal sheet. The distribution of the scintillations over the screen was determined by counting them at different parts of the screen. From the distribution curve the most probable angle through which the α-particles were turned in passing through the metal sheet under investigation could be found. In all experiments the scattering was measured by this angle, and the following results were obtained:—(1) The most probable angle of scattering increases for small thicknesses approximately proportional to the square root of the thickness of matter traversed by the α-particle. For greater thicknesses the scattering angle increases more rapidly. (2) The most probable angle of scattering is proportional to the atomic weight of the scattering material. (3) The most probable angle of scattering increases rapidly with decreasing velocity of the α-particles.—Dr. H. **Geiger**: The ionisation produced by an α-particle. Part ii., Relation between ionisation and absorption. Experiments are described which were undertaken to measure the velocity of the α-particles after passing through various sheets of mica of known stopping power. A thin wire, which was made highly active by the deposit from radium emanation, served as source of radiation. The α-particles emitted from it passed through a narrow slit and produced a small line of scintillations on a zinc sulphide screen. The deflection of the line in the magnetic field amounted to 1 cm. and more, and could be accurately measured by means of a travelling microscope. The relative velocities found in this way when different sheets of mica were interposed were up to 6 cms. of the range in good agreement with those previously obtained by Prof. Rutherford by a photographic method. Great difficulties were experienced in observing the scintillations when the α-particles had to pass through a thickness of mica nearly equivalent to the range. It could, however, be shown that the velocity decreased rapidly towards the end of the range. The lowest velocity which was measured corresponded to 0·27 of the initial velocity. The α-particles had in this case to pass through a thickness of mica equivalent to 6·8 cm. of air. The experimental results could be represented with good approximation by the equation $v^3 = a\ (\mathrm{R} - x)$, where a and R are constants, R denoting the maximum range of the α-particles. The curve indicates that the velocity becomes zero at the end of the range. In the course of the experiments an investigation was carried out to see whether all the α-particles from radium C are emitted with identical velocities. The experiment showed that the variation in the initial speed, if any, was certainly less than 0·5 per cent., but that the α-particles acquired a slight difference in velocity in passing through air. Assuming that the ionisation produced by an α-particle is proportional to the expenditure of energy, the equation representing the ionisation at any point of the path can be deduced from the above equation for the velocity. Taking into account the slight variation of velocity in a pencil of α-particles at the end of the path, the theoretical ionisation curve agrees fairly well with the experimental.—H. C. **Greenwood**: The influence of pressure on the boiling points of metals. The present research is a continuation of a previous paper dealing with the boiling points of metals under atmospheric pressure. Previous work at reduced pressures has been strictly limited by the lack of any material capable of maintaining a vacuum at high temperature, being, in fact, confined, except for a few metals of relatively low boiling point like zinc, to some observations in a very high vacuum. For similar reasons nothing has been done on the effect of high positive pressures. The difficulties here indicated were avoided by arranging the whole furnace inside an enclosure in which the desired changes of pressure could be produced. Heating was effected electrically, and the temperatures were measured optically, while the actual boiling point determinations were made by a method of visual observation similar to that before used. Observations were taken at pressures ranging from 100 mm. of mercury to 50 atmospheres. The order of magnitude of the effects produced is shown by the following example:—The boiling point of bismuth under 102 mm. of mercury is 1200° C., and under 16·5 atmospheres 2060° C., a variation of 860° being thus produced. The boiling points of all the metals studied (bismuth, copper, lead, silver, tin, zinc) were found to show a closely similar dependence on the pressure.—A. O. **Rankine**: The viscosities of the gases of the argon group. The viscosities of the five gases—helium, neon, argon, krypton, and xenon—have been compared with that of air. The method used was that described in a paper recently communicated to the society. The principal advantage of this method is that it enables the viscosity of quite a small quantity of gas to be determined with considerable accuracy. The total volume of the apparatus used in this case was rather less than 6 c.c. The values found for the viscosities of helium and argon are in close agreement with those obtained by previous observers. The results for the remaining three gases admit of no comparisons, these being the first determinations. All five gases are more viscous than air, the ratios η/η air being as follows:—

He	Ne	A	Kr	X
1·086	1·721	1·220	1·361	1·234

The viscosity of neon at ordinary temperature is far higher than that of any other gas hitherto experimented upon, and krypton is next in order of magnitude. As the atomic weight increases the viscosity alternately rises and falls. If, however, the mean free paths are calculated by using Maxwell's equation, they are found to decrease regularly with increase in atomic weight. The paper also contains estimates of the relative sizes of the atoms and their densities, the calculations being based upon the kinetic theory of gases. The conclusions arrived at are that the densities of the atoms of neon, krypton, and xenon are the same, and three times as great as that of helium. The argon atom is nearly twice as dense as the helium atom.

Physical Society, February 11.—Dr. C. Chree, F.R.S., president, in the chair.—Prof. H. L. **Callendar**: *Presidential address.* The application of resistance thermometers to the recording of clinical temperatures. The objections to thermocouples are twofold. The E.M.F.'s developed are so small that the recording instruments must be very sensitive and therefore unsuitable for ordinary use. Serious difficulties arise with regard to the thermostat necessary to maintain one of the junctions of the thermocouple at a constant temperature. The chief difficulty in connection with the use of resistance thermometers lies in the heating effect of the current. It was pointed out that in platinum thermometry, to obtain accurate compensation for the resistance of the leads, it is necessary that the ratio arms of the Wheatstone bridge should be equal, and it was shown that this condition reduced the sensitiveness to be obtained by suitably varying the resistances by about 30 per cent. In joining up a bridge in work with resistance thermometers, Maxwell's rule for the positions of the battery and galvanometer which give maximum sensitiveness is seldom applicable. While Maxwell's arrangement actually gives the greatest sensitiveness, the heating effect of the current is so much greater that this more than counterbalances the increased sensitiveness. The problem to be solved in designing a suitable thermometer for clinical work is, with a given galvanometer and resistance-box, to find the resistance of the thermometer which will give the most accurate results for a given heating effect of the current. This is given by the equation $\mathrm{R} = 2\mathrm{G} + \mathrm{S}$, where G is the resistance of the galvanometer and S that of one of the ratio arms. It is important in the construction of a thermometer for clinical work to secure quickness of action and to reduce the heating effect of the current. An ordinary tube-form of thermometer is good for laboratory work with sensitive galvanometers, but it is unsuitable for use with recorders. The pattern of the thermometer must be suited to the purpose for which it is intended. Three types were shown, designed for mouth, rectal, and surface work. Continuous records obtained from a patient with a normal temperature were shown. The temperature is generally very steady if the thermometer does not shift or the patient get wholly or partly out of bed. The effects of external changes of temperature were also shown, and simultaneous records taken on different parts of the body illustrated the fact that the temperature does not vary in the same way at all places.

Royal Meteorological Society, February 16.—Mr. H. Mellish, president, in the chair.—E. **Mawley**: Report on the phenological observations for 1909. During the whole year wild plants came into blossom behind their usual time, the departures from the average being greatest in March and April. Such early spring immigrants as the swallow, cuckoo, and nightingale made their appearance rather earlier than usual. The only deficient farm crops were beans, peas, and hay. On the other hand, the yield of wheat, barley, oats, turnips, mangolds, and potatoes was well above the average, and more particularly barley and turnips. The crop of apples, pears, and plums was under average, whereas that of raspberries, gooseberries, currants, and strawberries, taken together, was fairly good. As regards the farm crops, this was the fourth year in succession in which the yield has been above average.—Colonel H. E. **Rawson**: The North Atlantic anticyclone. The author has examined the "Synchronous Weather Charts of the North Atlantic" published by the Meteorological Office for the months of September, 1882, to August, 1883, and has analysed the tracks of the centres of high-pressure areas during that period. He finds that it is very rare for an individual system which has traversed the American continent to cross the ocean from land to land. In every month centres of high areas which have drifted across America and have travelled out on to the ocean are found coalescing there with one another or with the centres of the persistent Atlantic anticyclone. From mid-February to mid-September the charts indicate that on arrival on our coasts systems extend westwards, and their centres reverse their easterly movement and drift to the west, while in June and July the centres of high areas form over the ocean within the Atlantic anticyclone rather than drift into it from the American continent.

Institution of Mining and Metallurgy, February 17.—Mr. Edgar Taylor, president, in the chair.—Bede **Collingridge**: Errors due to the presence of potassium iodide in testing cyanide solutions for protective alkalinity. The results of experiments made by the author show that potassium iodide exercises an important influence on cyanide solutions, especially on solutions which contain no protective alkali, since in testing these in the presence of potassium iodide they show protective alkalinity. This fact is of considerable interest in cyanide plants, because cyanide decomposes more rapidly in solutions deficient in protective alkalinity than in those protected by an alkali, and the method adopted by the author for testing without potassium iodide would therefore imply a marked saving of cyanide in the case of large plants.—A. R. **Andrew**: The detection of minute traces of gold in country rock. In the course of investigations made for the purpose of determining the presence, or otherwise, of minute traces of gold in the shales and greenstone of Merionethshire, the author found that he was unable to believe in the trustworthiness of the methods usually adopted for that purpose, particularly as regards the possibility of obtaining litharge or any sort of lead absolutely free from gold and silver. On that account he claims that no credence should be given to any alleged detection of minute traces of gold in country rock unless accompanied by a full account of the means by which the purity of the litharge is assured.—W. A. **MacLeod**: The surface condenser in mining power plant. The author conducted a number of tests on the winding engines of a mine with which he was connected, the results of which are embodied in this paper, together with a vast amount of other information concerning the relative consumptions and efficiencies of condensing and non-condensing engines. He found that the employment of condensers was distinctly beneficial in both respects, even under the intermittent conditions attaching to most mining power plants, and the results of his investigation have enabled him to determine with some exactness the leading features to be emphasised in the laying down of a condensing plant suitable for work of a more or less intermittent nature, as is the case of winding engines.

CAMBRIDGE.

Philosophical Society, January 24.—Dr. Hobson, vice-president, in the chair.—R. R. **Mines**: The relative velocities of diffusion in solution of rubidium and cæsium chlorides. The rates of diffusion of salts into a gelatine jelly were compared by measurement of the progressive changes in the electrical conductivity at a fixed distance below the surface of the jelly when in contact with decinormal solutions of the salts. The concentration of salt corresponding to each reading was obtained from Kohlrausch's tables. Experiments carried out with lithium, sodium, and potassium chlorides gave results which agree with the values found by previous observers for the relative rates of diffusion of these salts in aqueous solution. This was considered to justify the extension of the method to rubidium and cæsium chlorides, as to the rates of diffusion of which no data were available. Rubidium chloride was found to diffuse slightly faster than potassium chloride, and cæsium chloride slightly faster than rubidium chloride.—L. **Southerns**: Experimental investigation as to dependence of the weight of a body on its state of electrification.—Miss D. B. **Pearson**: Note on an attempt to detect a difference in the magnetic properties of the two kinds of ions of oxygen.

PARIS.

Academy of Sciences, February 14.—M. Émile Picard in the chair.—G. **Lippmann**: A seismograph with a liquid column. A T-tube, full of water, is connected at each end with two basins of the same liquid. The changes of level in the arm of the T-tube are indicated by a thin disc of mica, connected through a suitable mechanism to a mobile mirror. To avoid friction, the disc does not touch the sides of the tube. Owing to this, slow changes of the vertical are not recorded by the instrument. The apparatus has the advantage that its period is invariable, depending only on the dimensions originally chosen, and the preliminary adjustments are much simpler than in the ordinary form of seismograph.—The perpetual secretary read a telegram from Dr. Charcot, summarising the work achieved by the Antarctic expedition.—Ernest **Esclangon**: The transformations of the Innes comet (1910*a*). Two diagrams of this comet are given, showing its appearance on January 22 and 30. Although there is no doubt that real transformations of considerable magnitude took place in this comet between the above dates, it is shown that an important part of the modifications observed, especially as regards the shape, is to be attributed to the changes in the angle at which it was observed. Observations of position are given for January 22 and 30, the conditions being especially good, and for February 9.—J. **Comas Solá**: The figure of the comet 1910*a*. Photographs were taken daily commencing January 20, and the resulting negatives discussed.—M. **Borrelly**: Observations of the comet 1910*a*, made at the observatory of Marseilles with the comet finder of 16 cm. free aperture. Positions are given for February 4, 5, 7, 8, 10, and 11.—Émile **Borel**: The definition of the definite integral.—J. **Le Roux**: Positive quadratic forms and the principle of Dirichlet.—Farid **Boulad**: The disjunction of the variables of equations nomographically rational of superior order.—Carlo **Bourlet**: The resistance of the air.—Mme. P. **Curie** and A. **Debierne**: Polonium. Starting with several tons of uranium mineral residues a preliminary treatment with hydrochloric acid furnished about 200 grams of material with an activity about 3500 times that of uranium, this activity being due to polonium. The hydrochloric acid solution was treated with ammonia to eliminate copper, the hydrates boiled with soda to dissolve lead, and then further treated with ammonium carbonate to dissolve uranium. The final residue of insoluble carbonates, obtained after several repetitions of these processes, were dissolved in hydrochloric acid and treated with stannous chloride. The original activity was concentrated in the final precipitate, which weighed about 1 gram. This was re-dissolved in hydrochloric acid, precipitated with hydrogen sulphide, the sulphides washed with sodium sulphide, and re-dissolved and again precipitated with stannous chloride. The final product of this lengthy series of operations weighed some milligrams, and was shown by spectrum analysis to contain mercury, silver, tin, gold, palladium, rhodium, platinum, lead, zinc, barium, calcium, and aluminium. The further purification presented great difficulties, but by electrolysis the activity was concentrated into about 2 milligrams of material. Activity measurements proved this to contain about 0·1 mgr. of polonium, and this is the quantity which ought to be found according to theory in two tons of a good pitchblende. Some lines in the spectrum are given which are probably due to polonium. The production of helium was proved, amounting to 1·3 cubic millimetres after 100 days, the theory requiring 1·6. An abundant disengagement of ozone was generally found near the substance.—L. **Décombe**: The measurement of the index of refraction by means of the microscope. A modification of Brewster's method. The liquid is placed between a plane and a plano-convex lens. In monochromatic light the refractive index can be determined to about 0·001.—P. Roger **Jourdain**: The alumina arising from the oxidation of aluminium amalgam in air.—Marcel **Delépine**: The dimeric aldehyde of crotonic aldehyde and the corresponding acid. A method of obtaining this substance with fair yields has been worked out, and the corresponding acid prepared and described.—J. **Bougault**: The action of nascent hypoiodous acid on the unsaturated acids: α-cyclogeranic acid.—Frédéric **Reverdin**: The action of concentrated sulphuric acid on some aromatic nitramines.—L. **Barthe**: The action of sulphosalicylic acid on trisodium phosphate.—. **Chevalier**: The forest resources of the Ivory Coast: the results of the scientific expedition to western Africa. Wood, rubber and oils.—L. **Blaringhem**: A new form obtained after mutilation, *Nigella damascena polycephala*.—J. B. **Gèze**: The agricultural development in the Bouches-du-Rhône of a spontaneous species of Typha (*T. angustata*) not previously noted in France.—L. **Léger** and Ed. **Hesse**: Cnidosporidia and the larvæ of Ephemera.—L. **Joubin**: A young Spirula.—Mme. **Phisalix**: The physiological action of the mucus of batrachians on these animals themselves and on snakes. This action is the same as that of snake poison.—L. **Jammes** and A. **Martin**: The adaptation of parasitic nematodes to the temperature of their hosts.—E. **Grynfeltt**: The tensor muscle of the choroid in teleosteans.—J. **Thoulet**: The genesis of the submarine rocks known under the names of *mattes*.—André **Brochet**: The relation between the radio-activity and richness in dry extract of the thermal waters of Plombières.—Louis **Besson**: A sort of white rainbow observed at Paris.

DIARY OF SOCIETIES.

THURSDAY, February 24.

Royal Society, at 4.30.—Colour-blindness and the Trichromatic Theory of Colour Vision: Sir William Abney, K.C.B., F.R.S.—Contributions to the Biochemistry of Growth: (*a*) The Total Nitrogen Metabolism of Rats bearing Malignant New Growths: (*b*) Distribution of Nitrogenous Substances in Tumour and Somatic Tissues: W. Cramer and H. Pringle.—The Alcoholic Ferment of Yeast Juice: Part V., The Function of Phosphates in Alcoholic Fermentation: Dr. A. Harden, F.R.S., and W. J. Young.

Royal Institution, at 3.—Illumination, Natural and Artificial: Prof. S. P. Thompson, F.R.S.

Institution of Electrical Engineers, at 8.

FRIDAY, February 25.

Royal Institution, at 9.—Colours of Sea and Sky: Lord Rayleigh, O.M., F.R.S.

Physical Society, at 5.—Telephone Circuits: Prof. J. Perry, F.R.S.—On the Laws regarding the Direction of Thermo-electric Currents enunciated by M. Thomas: Prof. C. H. Lees, F.R.S.—A New Method of Determining Thermal Conductivity: H. R. Nettleton.

Institution of Civil Engineers, at 8.—Irrigation Works: Sir R. Hanbury Brown, K.C.M.G.

SATURDAY, February 26.

Royal Institution, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

MONDAY, February 28.

Royal Society of Arts, at 8.—The Petrol Motor: Prof. W. Watson, F.R.S. (Lecture IV.)

Institute of Actuaries, at 5.—Some Notes on the Establishment of the Office of Public Trustee in England: W. C. Sharman.

TUESDAY, March 1.

Royal Institution, at 3.—The Emotions and their Expression: Prof. F. W. Mott, F.R.S.

Zoological Society, at 8.30.—On the Varieties of *Mus rattus* in Egypt, with General Notes on the Species having reference to Variation and Heredity: J. Lewis Bonhote.—Zoological Collections from Northern Rhodesia and Adjacent Territories: Lepidoptera Heterocera: Sir George F. Hampson, Bart.—The Urogenital Organs of *Chimaera monstrosa*: T. H. Burlend.

Institution of Civil Engineers, at 8.—*Further discussion*: The Hudson River Tunnels of the Hudson and Manhattan Railroad Company: C. M. Jacobs.

Royal Society of Arts, at 4.30.—Fruit Production in the British Empire: Dr. John McCall.

WEDNESDAY, March 2.

Society of Public Analysts, at 8.—The Composition of Painters' Driers: J. H. Coste and E. R. Andrews.—Note on the Analysis of Ultramarine Blue: E. R. Andrews.—The Colorimetric Estimation of Small Quantities of Bromine in the Presence of Large Quantities of Chlorine and Small Quantities of Iodine: W. J. Dibdin and Leonard H. Cooper.—Note on the Kjeldahl Estimation of Nitrogen in Fatty Substances: J. A. Brown.

Royal Society of Arts, at 8.—The Teaching of Design: E. Cooke.

Entomological Society, at 8.—Descriptions of New Algerian Hymenoptera (Sphegidæ): the late Edward Saunders.—On the Tetriginæ (Orthoptera) in the Oxford University Museum (Third Paper): J. L. Hancock.

THURSDAY, March 3.

Royal Society, at 4.30.—*Probable Papers*: The Depression of Freezing Point in very Dilute Aqueous Solutions: T. G. Bedford.—Sturm-Liouville Series of Normal Functions in the Theory of Integral Equations: J. Mercer.—The Solubility of Xenon, Krypton, Argon, Neon, and Helium in Water: A. von Antropoff.

Royal Institution, at 3.—Illumination, Natural and Artificial (Experimentally Illustrated): Prof. S. P. Thompson, F.R.S.

Röntgen Society, at 8.15.—Dental X-ray Technique: C. A. Clark.

Linnean Society, at 8.—Our British Nesting Terns: W. Bickerton.

FRIDAY, March 4.

Royal Institution, at 9.—Magnetic Storms: Dr. C. Chree, F.R.S.

Institution of Civil Engineers, at 8.—Reinforced Concrete as applied to Retaining-walls, Reservoirs, and Dams: A. J. Hart.

SATURDAY, March 5.

Royal Institution, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

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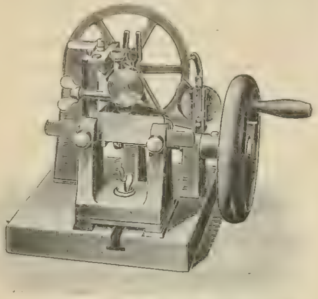

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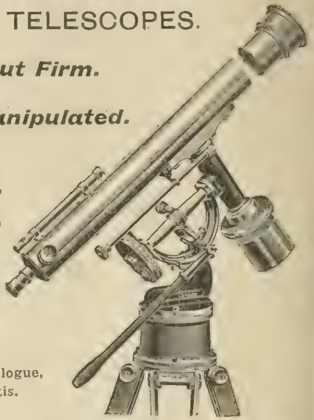

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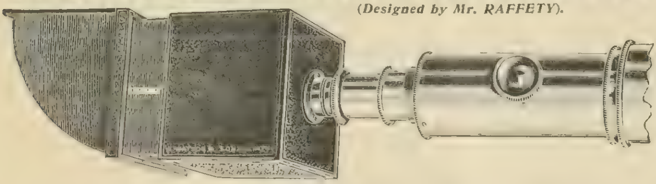

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